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THE

London Naturalist

(The Journal of the LONDON NATURAL HISTORY SOCIETY)

For the Year 1921.

Price Three Shillings.

PUBLISHED BY THE
LONDON NATURAL HISTORY SOCIETY,
[illegible] WINCHESTER HOUSE, OLD BROAD STREET, E.C.2.
L. Reeve & Co. Ltd., [illegible] Street, Covent Garden, W.C.2.

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Other Members of Council:

S. Austin, J. Ross, and L. J. Tremayne.

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LIST OF MEMBERS.

ADDITIONS AND CORRECTIONS TO THE LIST OF MEMBERS AND ASSOCIATES.

In addition to those referred to in the Obituary, the following names should be deleted from the 1920 list :—

Members ; ACHESON, BAKER, BARNES (H. J. & R. C.), BIRD, BOWMAN, COX, DIGBY (H.), GREENGRASS, GWATKIN-WILLIAMS, KIND, LATHAM (R.), LEGG, NEWBERY, RAVEN, ROBERTS, SIMES, SMITH (A. C.), STUART, TODD, WOOD. *Branch Associates :* BACOT, LEES. *Country Associates :* WOOD.

The following names should be added :—

New Member : E. O. BUTLER, 60, Sutton Court Road, W. 4. (Ent.). *New Branch Associates :* OSWALD F. COX and Miss M. GREENGRASS (from Members' List) ; STEPHEN LEIGH HUNT, "The Woodlands," Hale End, E.4. (Bot., Ent.) ; A. W. MERZ, "St. Mabyn's," Old Church Road, E.4 ; ARTHUR H. WARD, "Mayfield," Kimberley Road, E.4 ; W. A. WRIGHT, "Ringstead," Old Church Road, E.4.

Changes of Address : H. M. EDELSTEN to "Buntinghill," Balcombe Road, Haywards Heath, Sussex ; OLIVER G. PIKE to "The Bungalow," Leighton Buzzard ; Miss B. NICHOLSON, "Rothbury," Langdon Road, Upper Parkstone, Dorset.

PRESIDENTIAL ADDRESS.

(Read December 7th, 1920.)

When you did me the honour of electing me to the Presidential Chair I could not but feel some trepidation at being called to follow men of such high scientific attainments as those who have for recent years occupied that position. I should feel it a misuse of language to call myself a scientist, but if a love of nature and a keen pleasure in observing and studying natural history in many branches and acquiring a working knowledge of the phenomena displayed, makes a naturalist, to that title I may fairly lay claim. And when I recall my long association with this society and its forerunner the North London Society in which at one time or another I held office in many capacities, I have perhaps found some explanation of a choice which might otherwise have been inexplicable. However that may be, on this occasion you have honoured a general naturalist rather than an expert, and in the few remarks I have to make I propose to speak of natural history rather as a hobby, a mental and physical refreshment, than as a pursuit demanding lifelong devotion and full concentration of our powers. To the great majority of us, the necessity of earning our living makes such devotion impossible, even if we feel ourselves otherwise equipped for the task. There are of course degrees, and to some more than others are given the powers and the opportunities for serious scientific work, of which they have not failed to make good use. All honour to them. But in a society of amateurs such as this, most of the members inevitably regard natural history as a recreation, a relief from the strain and monotony of their workaday life. It has sometimes seemed to me that there is a tendency to decry this attitude as something trifling and unworthy, and that, although out of date, the spirit of intellectual snobbery that coined the phrase "mere collector" is not yet quite extinct. If it does exist it is quite out of place here. This Society was founded by mere collectors, is largely maintained by mere collectors, and should it cease to welcome the mere collector to membership, its career of usefulness would soon draw to a close. We may be collectors of butterflies, of plants, of birds' eggs, of nature photographs or we may simply collect records and observations of natural phonemena, but we are justified in our collecting if it harmlessly adds to our pleasure, and in the accumulation of facts and materials we are enlarging our minds and possibly, who knows, adding an essential stone to the structure of human knowledge. I take it for granted that we are in every case recorders as well as collectors. No naturalist is satisfied merely with the accumulation of specimens. At the least he keeps notes of the time and place and manner of their acquisition and unless he collects only in sale rooms he cannot fail to learn a great deal of the life and habits, the relationships and economy of the objects he acquires, and the addition to his note book of facts accurately observed and clearly expressed gives to his collecting a value which at the time may be unsuspected.

This year we celebrate the bicentenary of the birth of that great collector and recorder of *facts* Gilbert White of Selborne, "the father of natural history." Nearly all White's life was spent in the village where he was born. After a short school life at Basingstoke he went to Oxford, and took his degree at Oriel, where he gained a fellowship. But he put aside the academic career of an Oxford Don for the life of a country parson at Selborne, which, but for a brief return to his university as junior proctor, he never left again. Here he spent his ample leisure in the study of the natural history of his parish, and recorded much of the results of his careful observations in a series of letters, written in a clear and graphic style and with such grace and felicity of diction that they have become a classic of English literature and an inspiration to every naturalist. We cannot doubt that his life, uneventful as it was, was happily spent in his beloved village and its charming natural surroundings.

The circumstances of his time and situation, favourable as they were, largely denied to Gilbert White one of the chief pleasures of the naturalist, which we in this society may enjoy to the full. I mean the association of others like-minded with himself. In our periodical meetings we are enabled to increase our knowledge, solve our difficulties and sharpen our enthusiasm. But also in the field, in our collecting and observing, how our enjoyment can be heightened by the company of kindred spirits. Of the many scenes I can recall, let me briefly describe two or three.

In the clear light of a summer evening, filled with the sweet scents of the Forest around, we walk out from Lyndhurst across the heath to the sugaring ground at Hurst Wood. A few geometers are netted on the way and on reaching the oak wood the trees along the ride are soon sugared. Dusk falls as we pause by the edge of the heath, nightjars flick past and owls hoot in the trees behind, then lamps are lit and the round of the sugar begun. Moths are plentiful, and an occasional "good thing" keeps us alert and pleasurably excited. Anon with full satchels we walk back in the twilight of the midsummer night through the wood and the sleeping village to our rooms, where, over a plain but substantial supper we look through our captures and make plans for the following day.

Or let me recall another summer night, passed upon the flat shores of the East Coast, where during the short, dark hours we sleep—somewhat fitfully—in a hollow of the dunes, until the nightlong cries of the redshank and the distant roar of the sea are mingled with the song of the lark, and in the dawn we sit under a bank of sand boiling our spirit kettle for an early cup of tea, and watch the dainty ringed plovers probing the shores of the creek at our feet, and the swallow flight of the terns about their nests on the pebble ridge beyond.

Or again, high noon in a Swiss valley. Upon the steep hillside we stand knee-deep in grasses and vetches, pink trifoliums, blue campanulas and golden hawkweeds, almost bewildered by the wealth of insect life around us. Whites and clouded yellow, fritillaries and the puzzling Melitæas, burnets and skippers and coppers and blues in countless numbers, familiar many of them and yet on closer examination strange. How we revel in this naturalists' paradise! And comparing notes, adding knowlege to knowledge, we widen our views of genera, species and forms and begin dimly to realise something of nature's infinity.

To take one more scene. A wet winter night. In a cosy study, behind close-drawn curtains, with a good fire and plenty of tobacco sit two botanists. Sheets of specimens are piled on the table. A "critical" group is under discussion; and in examining, comparing, referring, the worries and discomforts of the past day are forgotten and time slips by unnoticed.

I have dwelt upon these happy memories, which, but for this Society, would probably never have been born, because I have sometimes thought that not all our members realise fully the advantages of association with others in their field work and study. Particularly I should rejoice to hear of younger members working together with the keenness and enjoyment which was characteristic of the Society twenty years ago. Perhaps they do. I hope so, for as the Society grows older, there must be added constantly the enthusiasm of youth if it is to remain a living force.

I have spoken of the pleasures of the naturalist and the enjoyment he derives, even as a "mere collector" in the pursuit of his hobby. But the tale of the advantages we may derive from the study of natural history is far from fully told. May I quote a passage by a well known writer, A. G. Gardiner, which in picturesque language presents another and wider aspect of the case. He had occasion to meet a man who was interested in boilers and machinery of all sorts. After much uninspiring talk on boilers by some means butterflies were mentioned. He continues "Whatever the cause, the effect was miraculous. He no longer looked at me as if I were a fellow-boiler; but as if I were his long lost and dearly loved brother. Was I interested in butterflies? Then away with boilers! Come, I must see his butterflies. And off we went as fast as petrol could carry us to his house in the suburbs, and there in a great room, surrounded with hundreds of cases and drawers, I saw butterflies from the ends of the earth, butterflies from the forests of Brazil and butterflies from the plains of India, and butterflies from the veldt of South Africa, and butterflies from the bush of Australia, all arranged in the foliage natural to their habitat to show how their scheme of coloration conformed to their setting. And as my friend, with growing excitement, revealed his treasures, he talked of his adventures in the pursuit of them, and of the law of natural selection and all its bearing on the mystery of life, its survivals and its failures. The hobby of his was, in short, his key to the world. At the magic word "butterflies" the prison door opened and out he sailed on the wings of passion in pursuit of things of the mind."

The writer goes on to point out what we as naturalists believe to be profoundly true. That the possession of a hobby is a steadying influence in our lives. It gives point and direction to our minds, food for the spirit of speculation and a path to the love of adventure that is in every man. Amid the tumult and perplexities of existence it provides a quiet anchorage where we can rest comfortably and cheerfully among things that we know, without fear of disillusion. And furthermore I think we can fairly claim that our love of natural history in strengthening our powers of observation, sharpening our critical faculties and leading us to cultivate a sound mind in a healthy body, is making of us better citizens, more worthy members of our day and generation.

ARCHAEOLOGICAL SECTION. REPORT FOR 1921.

1. Two members have resigned during the last year and two members have been elected, so that the membership remains at 20.

2. Four sectional meetings have been held during the year, an extra one being added besides the three allotted to the Section in the Society's rooms. These have largely been occupied with discussions on the Section's records, which have proved both useful and interesting. In addition however, Mr. Wattson has contributed a valuable paper on, "The Ornamentation of Norman Mouldings in England."

3. Three inspections have been made during the year: Namely, the church of St. Magnus the Martyr, Fish Street Hill, on February 26th, Stewkley Church, Bucks, on August 13th, and Bedfont Church, Middlesex, on October 22nd. Records of all these have been compiled, or are in the course of compilation, and are or will be in due course deposited in the Society's library.

4. The Section's arrangements, in common with those of others, were seriously interfered with by the national coal strike and other difficulties during the year. The projected week-end visit to Lacock Abbey in April had to be abandoned, as did also a substitutive week-end which had been contemplated for Stonehenge in October. Further, a visit to Waverley Abbey had likewise to be postponed, though it is hoped to bring this off next year.

5. The experiment was made of having a few informal expeditions to churches in the district, which it was hoped would attract members outside the section and widen their interests. But it cannot be said that the experiment was successful. The attendance in both of the two excursions tried was poor and almost confined to members of the section. On the other hand this may have been partly due to the time of year. The attendance generally speaking has been fair, and there are signs of increasing connection.

6. The scheme of recording inaugurated at the end of 1919 on the initiative of Dr. Simpson has been continued with some success. But its success have been almost entirely due to the indefatigable industry of our new Recorder, Mr. Stowell, who has taken up and carried on Dr. Simpson's work in a truly admirable manner, for which the warmest thanks of all our members are due to him. It is to be feared however, that Mr. Stowell has in many instances received inadequate support, and it is hoped members will do their best to rectify this. It cannot be to strongly impressed on all who join in the compilation of the records that a formal visit to the object to be inspected, before the actual inspection, is almost essential; but if, as is sometimes bound to happen, this is impossible, a visit after the inspection should be attempted, in order to see that all the work has been adequately dealt with and no point overlooked. It is further to be regretted that no new helpers have offered themselves, in spite of a pressing circular

which was sent round early in the year. Once more it is pointed out that the more widely this work is spread the less onerous it becomes on each particular individual; and it is hoped that every member of the Section will endeavour to take a part however small, in the very real and lasting work which it is doing for the Society.

The thanks of the Section are also due to Mr. Allingham for much valuable assistance in the photographic department.

7. The Second Annual Dinner of the Section was held at the "Ship Restaurant," Whitehall, on March 17th when Mr. Bishop was the guest of the evening accompanied by his sister, Mrs. Wilde. The function was well attended and much enjoyed.

8. Mr. Tremayne is succeeded in the Secretaryship of the Section by Mr. Allingham.

DOUGLAS B. ALLINGHAM, *Hon. Secretary.*
April 10th, 1922.

ARCHAEOLOGICAL INSPECTIONS, 1921.

St. Magnus the Martyr, E.C. 4.—Visited February 26th.

This renaissance example of Sir Christopher Wren's work, and one of the threatened City Churches was thoroughly examined and discussed by many members and visitors. Its history was traced back to Saxon times and it was noted that the Great Fire of London broke out close by. Apart from the Tower which was added in 1705 the main building was completed in 1676. The varied intercolumniation of the nave is explained by the fact that the original Wren building extended to the west end of the tower, which was then within the Church. After a second fire which ocurred in 1760 alterations were made by cutting off the west end of the Church at each side of the tower, and forming under it a passage way which became a public footway to old London Bridge. This arrangement exists to-day but through the rebuilding of London Bridge in 1831 the passage way is no longer necessary as a public one. The tower-steeple is a very fine example of Wren's work.

A question having been raised as to the construction of a beam spanning across columns 24′-0″ apart, it was generally agreed that the construction was timber and plaster although its appearance suggested stone. As somewhat to the detriment of the Renaissance, this delighted the Gothic enthusiasts.

The Record in the library touches on these and other points more fully.

St. George's Chapel, Windsor.—Visited March 19th.

Notice having been publically given of the temporary closing of this Chapel for extensive repairs opportunity was taken to examine this late 15th century example. Its general design and detail were compared with very similar buildings at King's College, Cambridge, and Henry VII. Chapel, Westminster.

Notes and sketches and photographs are in the Recorder's possession.

St. Catherine, Merstham, Surrey.—Visited August 6th.

Of this Church, of such varied interest, the early English tower should be noted and also the plan generally, as the development of parish church planning from the 11th century downwards can be studied from this example. Some notes and photo's are available for reference.

St. Michael, Stewkley, Bucks.—Visited August 13th.

Although this remarkable 12th century church has been much restored the work has been well done and practically the whole fabric is pure Norman in plan and detail. The latter is very profuse around doorways and windows. A rare embattled moulding was noted and the stair turret on the north side of the central tower was considered by some to be Norman, though all writers suggest 14th century. The Record in the library gives full detail. Compare Iffley.

St. Mary, Bedfont, Middlesex.—Visited October 22nd.

The originally small church at Bedfont has been considerably spoilt of late, but the original Norman chancel arch and south door of the same date together with other features made our visit extremely interesting. The Record discusses the relation of a recess on the south wall of the nave near the chancel arch and recessed wall painting on the north side to any rood loft there may have been. The main dimensions of those of the nave and chancel given by well-known writers and copied by subsequent publications, described as present day dimensions do not agree with our survey. Either the earlier writers were inaccurate or the building has been altered more recently than noted in contemporary accounts.

Hence the importance of checking rather than copying descriptions.

BOTANICAL SECTION. REPORT FOR 1921.

In reponse to the appeal of the Council for economy, the report of this Section for 1921 has been curtailed drastically. The publication of much important matter has been suppressed or postponed.

For the Northern portion, 5 new species have been added to the records, and 29 for the Southern. Noteworthy amongst the latter are *Silene nutans*, L., and *Mentha gentilis*, L.

Whilst on a visit to the Lake District, Mr. Hall found *Vicia orobus*, DC., *Circæa alpina*, L., *Primula farinosa*, L., *Juncus filiformis*, L., and *Carex aquatilis*, Wehl. At Hastings in October he also found *Amaranthus deflexus*, L.

In the course of a holiday spent in Dorset, Mrs. Wilde and Mr. Bishop observed *Scorzonera humilis*, L., (in its only known British station), *Drosera anglica*, L., *Linaria repens*, Mill. × *vulgaris*, Mill., *Iris fœtidissima*, L., var. *citrina*, Bromf., *Eriophorum gracile*, Roth., *Carex punctata*, Gaud., *Polypogon monspeliensis*, Desf. × *Agrostis alba*, L. (= *P. littoralis*, Sm.), and other rare species.

Mrs. Wilde has been unable to attend meetings, and has consequently resigned the Secretaryship of the Section. Mr. Bishop has been appointed Corresponding Secretary and Recorder, and Mr. W. Watson, Minuting Secretary.

Members are invited to bring the Section and the Society generally to the notice of their friends, and are urged to do all in their power to introduce new members.

The Recorder repeats his appeals of previous years for lists of plants observed in the Society's district.

R. W. Robbins, *Chairman.*
E. B. Bishop, *Secretary.*

LEPIDOPTERA SECTION—ANNUAL REPORT, 1921.

The Section cannot yet congratulate itself upon a return to its pre-war standard. The losses in our ranks are not yet made good. There has, however, been an appreciable increase in the attendance at meetings and it is satisfactory to record that this increase has been specially marked in the case of field meetings. It may be that field-work provides at present the most useful form of activity for the section, and it is proposed to pursue this branch of study with some care.

Seven meetings were held at Winchester House during the year under review and three field meetings. There are no additions to the entomological fauna of the district to record. The Section is interested in the re-arrangement of the Society's collection of Lepidoptera and it is hoped that this work may lead to the amplification of the district lists, besides rendering the collection more useful to members. It will assist the Section if members possessing duplicate specimens in good condition, of any species, however common, taken in the district, will present them to the Society. Specimens from the Southern portion of the district are particularly needed.

E. A. Cockayne, *Chairman.*
Harold B. Williams, *Hon. Sec.*

REPORT OF THE ORNITHOLOGICAL SECTION FOR 1921.

1. The Annual Meeting of the Section was held on December 20th, when the following officials were elected to form the Committee for 1922:—Mr. W. E. Glegg, Chairman; Mr. S. Austin, Secretary; Mr. A. Brown, Recorder; together with Messrs. C. S. Bayne, J. E. S. Dallas and P. J. Hanson. Mr. C. S. Bayne was elected to represent the Section on the Publications Committee.

2. Five new members of the Society have joined the Section during the year, *viz.*:—Mr. and Mrs. Frank E. Lemon, Miss H. Watkins, and Messrs. J. P. Hardiman and S. T. T. Parsons.

3. The Section provided the following papers for the Society's Syllabus, which were read at Ordinary Meetings, *viz.*:—On May 3rd, "Scottish Heronries," by Mr. H. Boyd Watt, M.B.O.U.; on November 22nd, "Bird Protection—the Work of the Royal Society for the Protection of Birds," by Mr. J. R. B. Masefield, M.A. Three Sectional Meetings were held, at which the following papers were read:—January 18th, "The Raven," by Mr. D. H. Meares; June 21st, "The Cuckoo," by Mr. R. Hay Fenton; September 20th, "Observations on the

habits of some Shore Birds," by Mr. C. S. Bayne. On January 10th our chairman repeated his paper on "Macedonian Birds" to the members of the Chingford Branch, and again assisted them with a short lecture on the "Birds of Epping Forest" on March 14th.

4. The monthly Field Meetings of the Section bid fair to become a permanent and successful feature of our activities; two of the meetings were abandoned by reason of unforeseen circumstances, but the following were held:—

January 23rd.	Upminster.	Leader,	Mr. L. Eynon.
February 20th.	Mimms.	,,	Mr. L. J. Tremayne.
March 20th.	Stanmore.	,,	Mrs. G. E. Thomas.
April 24th.	Limpsfield.	,,	Mr. R. W. Robbins.
June 26th.	Headley.	,,	Mr. J. E. S. Dallas.
August 7th.	Theydon Bois.	,,	Mr. P. J. Hanson.
August 28th.	Battlesbridge.	,,	Mr. W. E. Glegg.
September 25th.	Higham Marshes.	,,	Miss G. M. Towsey.
October 30th.	Tilbury.	,,	Mr. P. W. Horn.
November 27th.	Bromley.	,,	Mr. W. E. Glegg.

On November 26th, a visit was paid to the Ornithological Department of the Natural History Museum under the guidance of Mr. N. B. Kinnear, C.M.Z.S. It is proposed to arrange for similar visits in our future programmes. Your Committee held three meetings during the year.

5. It has been arranged to publish in the Transactions the paper read by Mr. R. Hay Fenton on "The Cuckoo" (see pp. 1-9), and the Sixth Annual Report on the Birds of Epping Forest will be printed, as usual (see pp. 70-75).

6. Only 7 birds were "ringed" during the year under the "British Birds" Marking Scheme. Members are urged to give more attention to this important branch of our work.

7. The photographic collection of birds and nests now numbers 116 sheets.

8. Three species new to the Society's district have been recorded, making the total number 162. These new occurrences are:—*Motacilla alba* (White Wagtail), September 4th, 1921, Chingford Plain, recorded by Messrs. Glegg and Austin; *Phalacrocorax carbo* (Cormorant), August 6th, 1921, two immature birds on an island of No. 5 Reservoir, Walthamstow; August 20th, one on the Racecourse Reservoir; August 27th, two on the Racecourse and two perched on a tree on an island on the High Maynard Reservoir. Subsequently on the Racecourse as follows:—September 3rd, two; September 10th, one; September 24th, two; October 1st, one; October 8th, two; on all the visits the birds were resting on an island; recorded by Mr. W. E. Glegg (see "British Birds," vol. xv., p. 213; and "Essex Naturalist," vol. xx., part 1, p. 47). *Colymbus stellatus* (Red-throated Diver), one shot near sluice house, Walthamstow Reservoirs, November, 1911, by Mr. Dakin (specimen now in the Essex Museum at Stratford), reported by Mr. W. E. Glegg; a bird in winter plumage was observed on the Upper

Penn Pond, Richmond Park, on February 13th, March 13th and 20th (see "British Birds," vol. xiv., p. 261), recorded by Miss G. M. Towsey and Mr. J. E. S. Dallas.

9. Other interesting records are as follows :—*Corvus corone* (Carrion Crow), observed in parties on the Walthamstow Reservoirs :—February 5th, 1921, twenty; October 8th, twenty-five; November 19th, thirty-two; December 3rd, thirty; recorded by Mr. W. E. Glegg (see "Essex Naturalist," vol. xx., part 1, p. 47); *Fringilla montifringilla* (Brambling), High Beach, flock of about 17, April 20th, 1921, recorded by Mr. P. D. Hayward (per S.A.); *Motacilla boarula* (Grey Wagtail), Loughton, September 1st, 1921, recorded by Mr. Percy Thompson (per W.E.G.); Woodford Green, October 31st, 1921, recorded by Mr. H. C. Playne (per S.A.); and Hatch Plain, December 16th and 25th, 1921, recorded by Mr. W. E. Glegg; *Locustella naevia* (Grasshopper-Warbler), Loughton, middle of May onwards 1921, recorded by Mr. V. G. Davey (per S.A.); *Saxicola rubicola* (Stonechat), Loughton, nested July, 1921, recorded by Mr. V. G. Davey (per S.A.); *Œnanthe oenanthe* (Wheatear), Chingford Plain, September 4th, 1921, recorded by Messrs. Glegg and Austin, *Spatula clypeata* (Shoveler), Walthamstow Reservoirs, August 27th, 1921, three at least, recorded by Mr. W. E. Glegg; *Scolopax rusticola* (Woodcock), Loughton, December 12th, 1921, recorded by Mr. P. D. Hayward (per S.A.); *Tringa hypoleucus* (Common Sandpiper), South Weald, Essex, August 26th, 1921, recorded by Mr. P. W. Horn; Staines Reservoir, August 11th, 1921, recorded by Mr. W. E. Glegg; Walthamstow Reservoirs, August 6th, 20th and 27th, 1921, recorded by Mr. W. E. Glegg (see "Essex Naturalist," vol. xx., part 1., p. 47); *Tringa ochropus* (Green Sandpiper), Ockenden, Essex, August 11th, 1921, recorded by Mr. P. W. Horn; Walthamstow Reservoirs, August 20th and 27th, 1921, recorded by Mr. W. E. Glegg (see "Essex Naturalist," vol. xx., part 1., p. 47); *Numenius arquata* (Curlew), Loughton, September 7th, 1921, recorded by Mr. P. D. Hayward (per S.A.); *Larus fuscus affinis* (British Lesser Black-backed Gull), Walthamstow Reservoirs, two, September 24th, 1921, recorded by Messrs. Bayne and Glegg (see "Essex Naturalist," vol. xx., part 1., p. 47); *Podiceps cristatus* (Great Crested Grebe), Staines Reservoir, 100 to 150 birds, August 11th, 1921, recorded by Mr. W. E. Glegg (see "British Birds," vol. xv., p. 90).

10. We have to thank the following observers for their assistance in compiling our local records during the past year, *viz.* :—Miss G. Lister, Messrs. R. S. Archbould, V. G. Davey, P. D. Hayward, and P. G. Thompson.

S. Austin, *Secretary.*

REPORT OF THE PLANT GALL SECTION, 1921.

The section has held three meetings during the past year at which papers were read and discussions took place on the galls on Compositae, Labiatae, and Rosaceae respectively, and various specimens were exhibited.

Species new to Britain have been shown and records of rare species noted at the ordinary meetings of the Society.

Owing to causes outside our control the expeditions fixed for the summer had to be abandoned, but in spite of this a good deal of material has been collected, and observations made by the members independently.

The following are some of the more interesting records:--Galls on Oak have been very irregular. *Andricus globuli* which was so abundant in 1920 has not been noted this year. *A. collaris* was very rare on *Quercus robur*, but was found on *Q. cerris* at Bedfont, Middlesex. *Neuroterus numismatis* was by far the most plentiful of the spangle galls, being very abundant in various places round London and also in Yorkshire. *Dryophantas* were very scarce. Old galls of *Andricus circulans* were plentiful on *Q. cerris* near Hanworth, Middlesex, and were also found near Horsley, Surrey.

Eriophyes galii has been observed frequently but was not nearly as ubiquitous as it was last year on various species of *Galium*. The white hairy gall recorded last year on *Galium aparine* from near Bedfont was not to be found this year, and only one root of the plant was to be observed in the summer on the area occupied by the galls last year. In October a lot of young plants were to be seen, but no galls.

Eriophyes convolvens on *Euonymus europaeus* was found near Horsley. *E. euaspis* on *Lotus corniculatus* in Yorkshire. *E. tiliae var. exilis* on *Tilia grandifolia* near Leatherhead. *E. macrotrichus* on *Carpinus betulus* in Bucks. *E. atrichus* on *Stellaria graminea* in Yorkshire. *Salvia verbenaca* was found in Surrey covered with white hairs possibly due to *E. salviae*. On September 9th, Mr. L. B. Hall found live *Eriophyes* in large numbers on galls attributed to *E. triradiatus* on *Salix fragilis*.

Perrisia acrophila on *Fraxinus excelsior* was plentiful in one district near Perivale, Middlesex, *P. silvicola* was found on *Stellaria holostea* in Bucks, *P. bryoniae* was again seen near Hanwell, Middlesex. *P. carpini* on *Carpinus betulus*, Bucks, *P. tubicola* on *Cytisus scoparius*, Yorkshire. And several larvæ of a *Cecidomyid* on *Ballota nigra* (Houard 4849) at Chiswick, Middlesex, and near Tilbury, Essex.

Unidentified larvæ were found galling flower heads of *Solidago virgaurea* and *Centaurea nigra* in Yorkshire.

Isosoma graminicola was found on *Agropyron pungens* and *Aphis atriplicis* on *Atriplex littoralis* between Purfleet and Tilbury. *Pemphigus filaginis* on *Gnaphalium uliginosum* was found north of Bracknell, Berks, and an unidentified micro-lepidopterous larva causing a swelling in the stem of *Beta maritima* near Tilbury.

Mr. L. B. Hall recorded species of galls observed by him in the Lake district including *Eriophyes stenaspis* on *Fagus sylvatica* and what appears to be *Andricus sufflator* on *Quercus robur*, both from Cumberland.

Harold J. Burkill.
Recorder.

79, Cornhill, E.C. 3.

December 31st, 1921.

CHINGFORD BRANCH—REPORT FOR 1921.

There has been again an improvement in the attendances of the Chingford Branch meetings, the lowest being 19 on an unfavourable evening and the highest 38 showing an average of 28 as against 25 in 1920.

There have been nine indoor meetings, at 8 of which the following papers or lectures were given :—" Macedonian Birds," by W. E. Glegg, F.Z.S ; " Notes on aquatic insects," by C. L. Withycombe, B.Sc. ; " Short lectures on Epping Forest," by A. G. Hubbard, B.Sc., W. E. Glegg, and A. Capleton ; "Medicinal Plants," by J. G. Everett, Ph.C. ; " Darwinian Selection and Disease," by Dr. Greenwood ; " Alpine Notes and Recollections," by E. Samuelson ; " Water Plants," by Miss G. Lister, F.L.S. ; " Bees and Bee-keeping," by A. Bacot, F.E.S. ; At the December meeting there was an exhibit of Microscopes which was much appreciated. The branch suffered a loss in the death of Mr. H. Y. Loram, F.I.C., one of the oldest and most active members and a man of considerable scientific attainment especially in the region of Geology and Mineralogy.

A. G. Hubbard, B.Sc., *Branch Chairman.*
E. Samuelson, *Local Secretary,*
39, The Ridgeway, E. 4.

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OBITUARY.

ARTHUR W. BACOT.

Rarely, if ever, has the entomological world sustained, within the course of a few brief months, two such heavy losses as have befallen it in the deaths of Dr. T. A. Chapman, last December, and of Arthur W. Bacot, on April 12th of the present year. Rarely indeed has such a double tragedy been even possible, for it is scarcely too much to say that they were, in their respective spheres, the two towering figures of our time, and that they should have lived and worked side by side was in itself a thing of no every-day occurrence.

The subject of this memoir, as is already only too well-known to many of our readers, was another of the ever-lengthening line of "martyrs to science," a victim of typhus in Cairo, where he was engaged in researches for which his invaluable services had been lent to the Egyptian Government by the Lister Institute. Those of us—and there are many—who have known and loved him and have appreciated his absolutely selfless devotion to the cause of science and of humanity, will be ready to endorse the saying of a friend, already published in the "Daily Chronicle," that if ever a man deserved the Victoria Cross, that man was Arthur Bacot.

By a Society formed by the fusion of the City of London Entomological and Natural History and the North London Natural History Societies, the name of Arthur Bacot will be held in peculiar honour. A member of the latter from its foundation in 1892, and of the former from the same date, a regular attendant at their meetings and excursions, a constant contributor for many years to their discussions and exhibitions, always alert and ready with helpful criticism or original suggestion, yet never self-assertive or opinionated, he exerted an influence over his fellow-members which can never be calculated. Perhaps especially of the North London, he was one of the pillars. He sat on the Council continuously from 1894, occupying the entomological curatorship in 1900, a vice-presidency from 1903 to 1908, and again of the amalgamated society from 1915, and the presidency in 1912 and 1913. He did invaluable work for the Biological Research Committee between the years 1904 and 1910, besides rendering useful service to the Lepidoptera Section. He was also a Fellow of the Entomological Society of London from 1901, and served on the Council from 1916 to 1918.

Handicapped in his youth by indifferent health and consequent limitations of his educational opportunities, Bacot more than made up for this by his assiduous reading and his cultivation of habits of logical thinking and reasoning. He was a keen lover of nature and an almost indefatigable field-worker, but if he ever suffered from the "mere collector" complaint he must have very quickly outgrown it, and almost our earliest recollections of him are of the keen and wideawake observer, always athirst for more knowledge, always desirous of fitting each newly-noted fact into the "scheme of things."

Although it is not altogether easy to single out his *forte*, where he excelled in so many things, it is perhaps safe to say that the larval stages of the Lepidoptera afforded his favourite study, and even as far back as the "nineties" he was a recognised master in breeding and describing these, as such papers as that on "The Genus Smerinthus" ("Ent. Record," vi., 173-81, 1895), "The Relationship of *Endromis versicolor* to the Sphingides" (ibid, vii., 227-30, 246-8), and others, will bear witness. Other groups of whose ontogeny and phylogeny he enormously advanced our knowledge, especially during the first decade of the present century, were the *Liparidae* and *Lasiocampidae*, besides some Saturniids, some Arctiids, etc.

The wider problems of biology had always the greatest fascination for him, and he was an able exponent of Weismannism, which he whole-heartedly embraced (vide the "Century Number" of the "Entomologist's Record," vol. xiii., pp. 44-47), a careful and open-minded student of Mendelism, of Thayer's view of Protective Coloration, and indeed of every theory worthy of serious thought, and his was an important share in the shaping of the paper on Neo-Lamarckism (October, 1905), and others which were given by the Biological Research Committee of the North London Natural History Society. Hybridisation also attracted him, and he has left his mark on the literature of hybrid *populi-ocellatus*, hybrid *Tephrosia*, etc.

From the commencement of Tutt's colossal work on the "British Lepidoptera" (1899 *seq.*) Bacot was an ungrudging collaborator, and his magnificent work in connection with that undertaking is eulogistically referred to in the prefaces to the volumes, but is really beyond all telling; only those who have had an occasional "peep behind the scenes" can form any conception of what it meant for a busy man to retain the threads of the breeding, describing, revising, summarising and correlating, during those strenuous days.

In 1909 the Royal Society published ("Proc.," Series B., vol. 81, p. 133) Bacot and Prout's Memoir on the cross breeding of two races of *Acidalia virgularia*. This was to be almost the last of Bacot's larger contributions to the study of the Lepidoptera; henceforth he was to work in another field.

Shortly after he settled in Loughton—early in 1909—he was introduced to Professor C. J. Martin, F.R.S., Director of the Lister Institute, and a member of the Advisory Committee for Plague Investigations. It had already been established that the rat flea was responsible for the transmission of bubonic plague from rodents to man, but, although the morphology and taxonomy of this insect had been closely studied, its bionomics were almost untouched. Professor Martin recognised at once that Bacot was the man to gain the needed knowledge, and at his suggestion the Advisory Committee invited Bacot to undertake the enquiry. At this time Bacot's name was hardly known outside the circle of Lepidopterists, and the Committee had no power to offer him a permanent post. What was done was to provide him with a laboratory assistant and apparatus. Thus assisted he fitted up a rough laboratory in his garden and, in the time left *after the exclusion of the hours from nine in the morning to six in the evening on five days a week*, he investigated the bionomics of fleas. The product, which in its final form occupied 206 pages of the "Journal of Hygiene," is one of the classics of Entomology. All the questions asked by the Committee were answered, and Bacot's position as one of the great investigators of his time was at once established. Some of his later work, such as his discovery (in collaboration with C. J. Martin) of the precise mechanism of transmission of plague from flea to man, was more dramatic; none was more romantic in the proper sense of that word. In the time to come, the literally true statement that the "Study of the Bionomics of the Common Rat Flea" was conducted in a disused stable in the leisure moments of a man who spent nine hours a day in a city office will be deemed an impudent invention. Bacot, however, had his reward—a very modest one as men judge such things, but to him a source of great happiness. At the end of 1911 the Governing Body of the Lister Institute created a post of Medical Entomologist on their staff and invited Bacot to fill it. He entered upon his duties early in 1912, and the almost dreamlike happiness of his first year of wholetime service in the cause of science is to his intimates a fragrant memory. Custom did not stale this, and it is certain that, if he could have foreseen the end, he would not have exchanged the ten ensuing years for thirty under other conditions. Between 1912 and 1922 he published more than thirty papers—all valuable; some classical. They reveal the same powers of scientific imagination and accurate observation, re-inforced by a steadily widening knowledge of epidemiology and the phenomena of disease. Space does not permit of even a list of titles, but if one item were to be selected for mention, perhaps the "Report of the Entomological Investigation undertaken for the Yellow Fever (West Africa) Commission" (London, 1916, Churchill, p. 191), gives the best idea of his genius. In this report he communicated the discovery that the eggs of mosquitoes cannot develop in sterile water.

He concentrated upon the study of *Pediculi* in the latter years of the war, and was thence led to investigate the diseases, notably Trench Fever and Typhus, conveyed by these parasites. Being the foremost authority on the bionomics of lice, his services were requisitioned, first for the study of the typhus problem in Poland and then for a special inquiry in Egypt. The story of this last adventure is known to all our readers; Arthur Bacot died of typhus at Cairo, on April 12th. "The sacrifice of such a life is as sad as it is truly glorious." These words are from a letter addressed by the President of the Royal Society, Sir Charles Sherrington, to one of the present writers. The gallant soldier in the army of researchers would have valued that tribute from the commanding officer. Nor can we add anything to it. Those who knew and loved the man do not need to be reminded that they have lost more than a scientific colleague; to those who had not the privilege of his acquaintance no idea of his personal qualities can be conveyed in a few words.

Science has no place for championships. It is idle to dispute whether Laplace was a greater man than Darwin, or Helmholtz superior to Kelvin. It is even hard to say what we mean by the attribute "great." But there are not many connotations of the term which would render it inapplicable to Arthur Bacot.

THOMAS HUCKETT.

The death of Mr. Thomas Huckett took place on Friday, April 7th, 1921, at his residence in Islington.

He was an Honorary Member of the Society from 1908, and a Trustee of the City of London Entomological and Nat. Hist. Society from 1892 to 1907.

He was born in 1842, as was his old friend J. A. Clark (whose death occurred in 1908), and was one of the earliest members of the original Haggerston Entomological Society, of which he was President in 1883, when that Society sent a petition, with very many signatures, to Parliament against the G. E. Railway Bill for the proposed extension of the line from Chingford to High Beach.

His first introduction to entomology is believed by the writer to have been when he took a position as assistant to Edward Newman, who refers to him as furnishing him (Newman) with an unceasing supply of caterpillars for description in "The Zoologist." He was well acquainted with Henry Doubleday, of Epping, and another of the few remaining "links with the long past" has therefore been broken by his death.

Consequent on his many years of total blindness, patiently and bravely borne, he was unable to take an active interest in his beloved Entomology, but he eagerly awaited the writer's almost weekly visits with news of anything relating to collecting or rearing Lepidoptera, and the memory he showed, almost to the last, of the most minute details of form and colouring was most marvellous.—W.G.P.

The Society has also lost by death, during 1921, Dr. T. A. Chapman, Mrs. Hanson, Mrs. E. A. Nicholson, and Mr. H. Y. Loram.

BRITISH
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NATURAL
HISTORY.

THE CUCKOO.

By R. HAY FENTON.

(Read before the Ornithological Section of the L.N.H.S., on June 21st, 1921.

Although the chief aim of this paper is to deal with the eggs of the Cuckoo perhaps a few remarks by way of introduction about the bird itself and its habits may not be out of place. This well-known, interesting but mysterious, bird, which in size is somewhat less than a Pigeon, shaped like a Magpie and of a greyish ash, and in some cases light lavender grey colour, usually arrives on our southern shores from Africa about the middle of April. Its arrival varies—being either earlier or later as the season seems to be more or less forward, and the weather more or less inviting. Many of them rest for a day or two in the Channel Islands after their long and exhausting journey before they come to the mainland. The old birds leave again towards the end of July or beginning of August, the young, or birds of the year, following as best they can about the end of September or beginning of October. This mode of migration is exactly the reverse of other migratory birds, who allow the birds of the year to depart first on their unknown journey. Why the old Cuckoos, who feed largely on caterpillars, especially hairy ones, should be in such a hurry to get away while there is yet an abundance of suitable food is a mystery but it is said that the House Martin will leave a nestful of young to perish rather than be late when the time for departure arrives and it is suddenly seized with the migratory impulse. So it is just possible that it is such an impulse which impels the old Cuckoos to take an early departure. Once arrived they distribute themselves over the length and breadth of the land including the Islands of our Western Coast. They return year after year to the same locality and never wander very far from their favourite area. The domestic life of the Cuckoo is somewhat peculiar. They do not pair. No nest is built. The eggs are laid on the ground and carried by the female in her bill to the nests of the fosters selected to receive them, and if time and circumstances permit some of the foster's eggs are usually removed. This is no doubt done for a purpose, for when eggs are removed or destroyed the young Cuckoo when hatched has not so many birds or eggs to eject from the nest before it become the sole occupant. This habit, unique among British Birds, is practised by many others elsewhere, and in particular by the American Cattle Starlings. One of these indeed goes even farther, since it entrusts its egg to the care of a nest-building cousin. There are also American Cuckoos that build their own nests and incubate their own eggs. The Cuckoo not only removes eggs but it frequently kills young birds. The following incident was related to me by a collector friend in Lancashire. Some quarrymen knew of a Meadow Pipit's nest containing four young birds.

One afternoon they noticed a Cuckoo flying about near the nest. The young were quite well when the men left their work in the evening but on looking into the nest on the following morning all the young birds were dead. The cause of death was a single puncture in the abdomen. A fortnight after these men again found the Meadow Pipit's nest not more than ten yards from the site of the old one. This time it contained four eggs and one of a Cuckoo, so they came to the conclusion that the young birds of the first nest were deliberately destroyed in the hope that if another nest was built the Cuckoo could place an egg in it. A similiar instance of the young being killed is related by Mr. C. E. Milburn, in "British Birds," vol. 9, page 95.

If we take the average clutch of foster's eggs at four and consider the eggs destroyed and the young killed, the number of birds annually sacrificed must be enormous. In my own collection of 521 Cuckoo eggs the accompanying foster's eggs number 1853; add to this the number of eggs destroyed and the total cannot be far short of 2000 for 521. Ornithologists are not well agreed as to why the Cuckoo does not make a nest of its own and rear offspring like other birds. Some authorities think that as the males greatly outnumber the females the latter are so pestered by the attention of the males who chase them from place to place that they have no time to build a nest. Others say that they are too lazy. Not a few assert that they are so intent on feeding that the thought of a nest never seems to trouble them. Most works on ornithology tell us that the Hedge Sparrow and Meadow Pipit are the two birds most usually imposed upon. This is no doubt true to a certain extent, but it must not be forgotten that both birds are so common that their nests are available all over the country—especially that of the Hedge Sparrow; but in some districts where the nests of these two birds are fairly common other species are more favoured than they are. For instance at Sandwich, Huntingdon, Wisbech and Evesham, the Reed Warbler is the common foster. At Clitheroe in Lancashire the Yellow Wagtail, in the Fell district, the Twite, and in Pomerania the common Wren. Of 421 British-taken eggs in my collection 27 were found in Hedge Sparrow nests and 37 in the nests of the Meadow Pipit, but there are 30 Sedge Warbler, 32 Tree Pipit, and 64 Reed Warbler fosters, so that in this collection at all events Hedge Sparrows and Meadow Pipits are in the minority as foster parents. The number of birds who at various times have been imposed upon is very large. I myself possess 59 different fosters. Mr. E. Bidwell, in the "Ibis" of 1896, gave an interesting list of no fewer than 119, but I could add between 20 and 30 other birds who have fallen victims since this list was compiled. A very difficult foster for collectors to obtain is the Grey Wagtail. Full clutches of 5 or 6 are quite common about the 25th April, or something like 10 days after the arrival of the female cuckoo, so that by the time she is ready to lay the nests of the Wagtail contain young birds, and are therefore not available. However, when a second nest is built after the young of the first brood can fly, or when a nest is built to replace one already taken and contains eggs 12 or 14 days after, the Cuckoo—which by this time has commenced to lay—for some reason or another seems to avoid the nest of this species altogether. A correspondent who has seen hundreds of nests of the Grey and Pied Wagtails informed me that when the Cuckoo has the choice of both nests (and he has seen them placed almost side by side) it will always select the nest of the Pied Wagtail. This seems most extraordinary, because in this locality where the Grey, Pied, and Yellow Wagtails are all found, the Yellow Wagtail, which lays an egg somewhat like that of the Grey, is favoured almost to the same extent as the Pied, while the Grey is left severely alone. Although the nests of soft-billed birds are more frequently used than those of "hard-bills," I do not think the question of diet has anything to do with the Cuckoo's selection, because the young of all birds while in the nest are largely fed upon what one might call soft, sloppy food—insects and caterpillars. Besides, the young Cuckoo seems to have extra-special digestive organs which enable it to assimilate and thrive on the menu of any foster in whose nest it is hatched. One good reason why soft-billed birds are more favoured is that their nests are more numerous and consequently a greater number are at the service of the Cuckoo. Of the 59 fosters before mentioned 45 are soft-billed birds and 14 hard-billed.

The young Cuckoo is a most pugnacious and ill-behaved bird. What else could be expected? It is put out to nurse on the baby farming principle and has not the benefit of a parental upbring. I once found one sitting on the ground fostered by a pair of Tree Pipits, and when I gently touched it with my walking stick it rolled over on its back, showed fight by opening its capacious mouth and striking out with its feet like a young Peregrine. It may be of interest to say in passing that the young of the Peregrine, when the nest is on the face of an inacessible cliff, may be easily captured from above by attaching a ball of wool to a string and dropping it into the nest below. The young birds will roll over and claw the wool and getting their feet entangled in it are easily drawn up. The young Cuckoo is furnished with a cup shaped cavity in its back which fills up after the twelfth day and is apparently of no further use. When only thirty hours old it commences to fidget, and into this depression it hustles the other youngsters, and one by one ejects them from the nest so that it may receive the entire care and attention of the fosters. If any of the foster's eggs are still unhatched they share the same fate. Some years ago a friend found a young Cuckoo in a Robin's nest and the Robin's five eggs lying close beside, no doubt turned out by the young Cuckoo. They were all on the point of hatching. I have often wondered how a young Cuckoo fares when born in the domed nest a Wren, how it manages to eject the other occupants and crawl out itself before it gets too large to escape by the tiny aperture of the nest.

The appetite of the young Cuckoo is enormous and the fosters are kept busy all day long satisfying the hungry interloper. It has been noticed that the young rascal gets very impatient and seems to scold and peck at the fosters if supplies are not brought fast enough and in sufficient quantities. Such a scene was once witnessed by my brother who on several successive days watched a pair of Whitethroats feeding one. He assured me that the youngster seemed to read the old birds a lecture when they remained away longer than they ought to. It is not perhaps generally known that if for some reason or another a young Cuckoo is deserted by its foster parents it will soon be adopted and brought up by some other bird. This, too, is strange, as I believe all birds know instinctively that the Cuckoo is an enemy—just as one would say: "I don't like the look of that man or woman." A Yorkshire friend was watching a pair of Meadow Pipits feeding a young Cuckoo, when suddenly a Sparrow-Hawk pounced on and carried off one of them. The other bird continued to bring food, but apparently not in sufficient quantities to satisfy the Cuckoo, for it commenced to call louder and louder (I do not suppose for a moment it was lamenting the untimely end of its parent). At last a kindly Chaffinch appeared on the scene and took the place of the late Pipit, bringing food and feeding the youngster as if it has been one of the original fosters. My friend who witnessed this told me that he had frequently seen Blackbirds, Thrushes, Robins, and Hedge Sparrows, take compassion on and feed a Cuckoo when calling for food. I remember seeing a number of sparrows feeding on some bait which had fallen out of the nosebag of a horse. Among them was a young one who kept fluttering about begging to be fed, and as I was curious to know what would happen I watched it for a time and noticed four different adults come and feed it. Perhaps it was some such kindly feelings which prompted the different birds I have just mentioned to take compassion on the young Cuckoos. I do not pretend to know about music, but I believe the distance between the notes of the Cuckoo is a major third. As the season advances the key changes and the clearness of the two distinct notes is gradually lost and at last its voice breaks altogether. White, of Selborne, says that neither Owls nor Cuckoos keep to one key, the note varying in different individuals. About Selborne he found they were mostly in D. Two were heard singing together, the one in D and the other in D sharp, which made a disagreeable concert. The cuckoo is mentioned in the Book of Leviticus, at the 11th chapter and the 16th verse; but whether this is our Cuckoo or some other bird I will leave students of the Bible to decide.

Eggs of the Cuckoo may be found from the end of April till the middle of July. The 431 British-taken eggs already referred to were found as follows: 2 in April, 210 in May, 208 in June, and 11 in July.

The two April eggs were both taken in Robins' nests, on the 29th and 30th of that month. The last two July eggs were taken on the 14th and 15th, the first in the nest of a Hedge Sparrow and the second in the nest of a Reed Bunting. Generally the egg of the Cuckoo bears more resemblance to the egg of the Skylark than to that of any other British bird, both as regards size and markings, and it is sometimes rather difficult to identify them. However, an experienced collector can usually tell them at a glance. As a rule they are somewhat rounded at the thin end, and when carefully examined they will be found to be more or less covered with minute specks, as if a house fly had been walking over them. By the aid of a powerful glass these dark spots, which vary a good deal in number and size, will be found in many instances to be small indentations. In the blue type of egg to which I will presently refer, these indentations are also found and look as if the bird had accidentally put its claw through the shell and afterwards carefully filled up the holes with blue wax, but the mending is dull in comparison with the rest of the glossy shell. The best test, however, is to weigh a doubtful egg which if properly prepared is about 14% heavier than any other British birds egg of the same size. I weighed 50 blown eggs which gave the following result: 33 weighed 3 grains and 17 weighed 3½ grains.

Unblown eggs weigh from about 44 to 54 grains. The average measurement is 11½ lines long by 8½ lines broad. They are very small for the size of the bird, being, as I have already said, about as large as that of the Skylark. Yet the comparative size of the birds is as 4 to one. German taken eggs are not so fine and large as our British ones. They are as a rule rather smaller and do not show so much variations. Many of them bear a strong resemblance both in size and appearance to the eggs of the Blackcap and Garden Warbler. It is difficult to say how many eggs a Cuckoo lays in one season. Colonel Montagu mentioned 5 or 6, but I think that is much under the mark. In 1918 Mr. Edgar Chance found 10 by one bird, and in 1920 I believe he found 21 by another. In my own collection I have 3 sets of 6, 1 set of 7, and 1 set of 10.

I have also a set of 5, but it should really be a 7 set as other 2 eggs by the same bird are in the hands of another collector. By sets I mean two eggs and upwards laid by one bird, in the same year and locality, but in the nests of different fosters. Here I should like to read an extract from the letter dated 7th December, 1915, sent by my correspondent along with the set of 5 just referred to. The first part bears out my statement that the female Cuckoo never wanders very far from her selected area. The second part gives my correspondent's opinion as to the number of eggs laid by a single Cuckoo in one year. "The 5 Cuckoo sets were all taken in an area of certainly not more than 1¾ miles long by perhaps 5 or 6 hundred yards wide, and mostly in one dike of varying width and depth, and I may add some under most exacting physical conditions. The Reed Warblers have been parasited by them now, to my knowledge, for 3 consecutive years, but in 1912, when I discovered the colony, it was very late in the season and only young birds were found. Judging by the number of eggs and young I have found and seen in the area in a single year, I am inclined to think that this Cuckoo (and therefore probably some others) may deposit more than their reputed number of 10-12 eggs. I traced 9 in 1913, and some portions of the reeds are absolutely unworkable by any means available to me. I trust these notes may interest you." It is not known at what intervals Cuckoos lay their eggs, but Mr. Chance gave it as his opinion that the 10 eggs just referred to were laid between the 1st and 25th of June, a period of 25 days. The eggs in my 10 set were found between the 24th May and 15th June—a period of 22 days. Although the egg of the Cuckoo frequently resembles that of the foster in whose nest it is placed I do not believe it has the power to produce an egg of the same colour or type as that of the intended foster, any such resemblance being in my opinion purely accidental. There is a considerable variability of colour in Cuckoos eggs in general and a marked uniformity of colour in the egg of the individual bird. The Hedge Sparrow. which lays a blue egg, is a frequent foster, yet I am not aware that any well-authenticated blue egg has ever been found in this country. If the Cuckoo possessed the power of imitation to the extent some naturalists claim for it, one would naturally expect that the blue egg would be fairly common. A well-known collector died the other year and from his collection I was offered a blue egg taken at Barnham, Suffolk, along with 5 Pied Wagtails. The egg was certainly laid by a Cuckoo—and blue—but it was not a blue Cuckoo's egg. This may be a bit Irish, but what I mean is, it was not an egg of the blue type, and from an examination of the shell I came to the conclusion that it was laid by an old or diseased bird. It lacked the glossy colour of the true blue, and the indentations filled up with wax, to which I have already referred, were absent. If I could have removed the markings from some of the Cuckoo eggs in my own collection, I could have produced an exact duplicate. Blue eggs are frequently met with in Finland and Lapland. They are not only found in the nest of the Redstart, which lays a pale blue egg, but also in such nests as the Reed Bunting and Brambling and of course bear no resemblance to the eggs of either of these birds. After all the blue egg is only a type not a mimicry, for if a blue-laying Cuckoo dropped its egg into the nest of a Skylark it would not resemble the egg of that bird for it would still be blue. This also applies to another type found in the nest of the Orphean Warbler, which only by size and weight can be distinguished from that of the Warbler, so close is the resemblance. If the Orphean Warbler Cuckoo dropped its egg into the nest of a Hedge Sparrow it certainly would not be blue like that of the victim, because it had no power to alter its fixed Orphean Warbler type. Another type found in Hungary in the nest of the Great Reed Warbler is at present in process of evolution and will in time no doubt be exactly like the eggs of the foster. There is no manner of doubt about these eggs whatever. They are Cuckoo eggs and not abnormal eggs of the Warbler. Three eggs of this type and four eggs of the Warbler when weighed worked out as follows:—

The largest Reed Warbler's egg weighed 3 grains.

The smallest Cuckoo's egg 3½ grains and the largest Cuckoo's egg 4 grains.

A great objection to this imitation theory is that the Cuckoo cannot mimic an egg it does not see. The case of the common Wren in whose nest it sometimes places its egg is a good example, as the construction of the nest makes it utterly impossible for the Cuckoo to see the colour of the egg or eggs the nest contains. The Reed Warbler is a more frequented foster, but I doubt very much if the colour of the eggs could be seen by the Cuckoo owing to the depth of the nest, so that mimicry is in this case also impossible. Such imitation requires reasoning powers which no bird possesses, and a great deal more; for the bird might want to produce, say, a blue egg, but she has no control over the internal processes of her body, which result in producing such, and cannot do so.

The late Professor Alfred Newton, of Cambridge University, who wrote the article on the Cuckoo for the *Encyclopædia Britannica*, rejected with scorn the idea that individual Cuckoos had the power to vary their eggs in the least degree, the eggs laid by the same individual bird being, he held, always the same. Dr. John Rennie of the Aberdeen University, in his book "Aims and Method of Nature Study," is not so pronounced in his opinion. He makes the following observations: "The Cuckoo's egg has considerable range of colour and variation—that is, in a series. There is also what may be termed discontinuous variation—the pale blue egg—while this is so there is some evidence to show that the egg of the individual cuckoo probably does not greatly vary." His analysis of a series of 101 eggs gives the following result. "Sometimes—in twenty four cases—the normally-coloured Cuckoo egg resembles generally the egg of the foster bird. It is, however, usually easily recognised at first sight by the size. In 12 cases extreme variants of the egg resemble the foster-bird's egg. This includes 1 blue egg in a Redstart's nest. Sixty-five cases are indifferent; that is, there is no noticeable resemblance between the Cuckoo's egg and those of the foster parent." The authorities at The Natural History Museum, South Kensigton, go a step farther than Dr. Rennie for you may read on a notice placed beside a case of Cuckoo's eggs the following:—"As a rule the egg of the Cuckoo agrees more or less nearly in colouring with the eggs of the birds among which it is laid, although this is less commonly the case when it is deposited in a Hedge Sparrow's nest. It is accordingly believed that each individual female Cuckoo is in the habit of selecting, when possible, the same species of bird to act as foster parent."

To disprove this mimicry theory I have collected 26 Cuckoo sets, and any one with the most rudimentary knowledge of birds' eggs, on examining these sets would at once admit that a more striking similarity in size, colour and markings could not be found. One set of 6 taken by a reliable and trustworthy collector were found in the nests of five different fosters, 2 in the nests of the Sedge Warbler and 1 each in the nests of Reed Warbler, Whitethroat, Lesser Whitethroat and Hedge Sparrow. The ground colour of the eggs is a bluish-grey with brown speckles fairly distributed. The nests were built by the side of a river and were all found within a stretch of a mile, so, as I have remarked before, the Cuckoo does not wander very far from its favourite area. The resemblance of one egg to another in this set is absolutely perfect and if they were not all laid by one bird the extraordinary similarity of the eggs would point to a coincidence which a field ornithologist would consider impossible in view of the variability of Cuckoo's eggs. When Dr. Rennie read a paper on "Egg-colouration in the Cuckoo and its bearing upon the theory of Cuckoo Sub-species," before the Royal Physical Society of Edinburgh, in October, 1913, he exhibited 13 of these sets—50 Cuckoo eggs—and made the following comments on this one. "What is the probability, we may pertinently ask, of *5 distinct birds* in the same district all laying in the same season, each in *a separate foster species'* nest eggs so resembling each other in ground hue, depth and distribution of super-imposed pigment, that they cannot be distinguished from each other? Such is not likely to be the case; the probability is very remote." When I secured this set I thought it was impossible to improve upon it, but shortly afterwards I was fortunate enough to procure a beautiful and even more unique set of 11 in the nests of 4 fosters. One egg was taken in 1909 and 10 were taken in 1910. The fosters are two Reed Buntings, two Whitethroat, three Reed Warblers and four Sedge Warblers. Without doubt the eggs are all the produce of one bird for one egg cannot be distinguished from another. All the eggs have a pale russet zone round the large end, and when the 11 are laid out in a row one would imagine that some one with the aid of a ruler had neatly drawn a band across the lot and put on this delicate russet zone. On this set Dr. Rennie made the following comments:—"An unbiassed examination of these eggs and the foster clutches suggests the following observations:—

1. "There is a resemblance in colouration both as regards intensity and distribution which is remarkable.

2. "It is not surpassed nor even equalled in the colouration of the eggs composing the individual clutches in which the eggs have been found. There is noticeable variation in the different clutches of the same kind of bird's eggs, *that is*, Sedge Warblers, in this collection which contrasts with the uniformity of appearance of the Cuckoo's eggs of the series. We have here either the eggs of 2 or more birds, in which case a marvellous coincidence of colour resemblance extending to 11 eggs occurs; or the eggs are those of a single bird. If the latter alternative be correct, two facts of interest are to be noted. One is the confirmation of the observations of Baldamus and others that the resemblance in the eggs of the individual Cuckoo extends from one year to another. The second is that a single Cuckoo may lay as many as 10 eggs in a season, and that within so short a period as 22 days. Further, it will be noted there are four foster species involved; these, however, all nest in similiar situations. The actual distance limit of this Cuckoo's ovipositing operations here considered was about 2 miles."

After all one may ask what advantage, if any, would be derived from mimicry? The fosters either cannot or do not attempt to eject the Cuckoo's egg; neither do they desert their nest, although it has been tampered with and some of the eggs removed. My own opinion is that the small size of the Cuckoo's egg contributes more to its safety than any apparant resemblance, real or imaginary, to the egg of the foster parent. All this evidence I think favours my opinion that the Cuckoo has no power of imitation whatever and shows that, like other birds, it always keeps to the same permanent type. Seebohm mentions the case of a Guillemot which for 13 years in succession laid a very rare and highly prized egg on a certain ledge at Flamborough Head. In June, 1909, I found a Blackbird's nest near Waltham Abbey containing 4 very unusual eggs. On Good Friday, 1912, I again found the nest with 2 eggs exactly like those I found 3 years before, the bird still keeping to the same type, so it seems highly improbable that the Cuckoo should have the power to vary its eggs 10 or a dozen times in one year to match the colour of every new foster.

STRUCTURAL ABNORMALITIES IN LEPIDOPTERA.

By E. A. COCKAYNE, D.M., F.R.C.P.

References to abnormalities in insects are scattered through British and foreign periodicals, but they are often indexed in such a way that they can be found only by looking through the letterpress. The following attempt to collect and group those met with in Lepidoptera must be very incomplete. The grouping is provisional. A scientific arrangement is dependent on knowledge of the causes underlying structural abnormalities, and our knowledge of these is very slight. It is impossible even to separate abnormalities due to injury from inborn errors of development.

In spite of these deficiencies I hope this paper may be of some practical use for reference.

Homoeosis.

This term was first used by Bateson for a change of some thing into the likeness of something else.

Przibram has extended its use, calling Bateson's examples substitutional homoeosis, and making two further classes "redundant or adventitious homoeosis" and "translative homoeosis." Most of the cases of substitutional homoeosis consist of the substitution of one organ by another which is homologous with it; redundant homoeosis covers cases in which duplication of an appendage occurs, but the extra appendage appears in the form of an appendage homologous with the one from which it springs. Homoeosis is very rare in insects, and since examples in other orders throw some light on those in Lepidodtera, I will mention them as well.

Part of antenna replaced by tarsus.

Zygaena, male. The right antenna short, with its club ending in two tarsal claws, like those on the feet of a *Zygaena*, but about half the size. They were polished and chitinous, light brown in colour with darker tips. The left antenna was very similar, but the naked claws were almost hidden by scales (Klemensiewicz, Ill. Wchenschr f. Ent., 1900, v., pp. 168, 169). This very remarkable anomaly has been recorded in other orders. In Hymenoptera, *Bombus variabilis*, Schmkr., male, the antenna replaced by tarsus (Kriechbaumer, "Ent. Nachrichten, Berl.," 1889, xv., p. 281).

Bombus agrorum, Latr. Similar condition (Doumerc, "Ann. Soc. Ent., France," 1834, iii., p. 171).

Halictus, with both antennæ formed like legs, of which only the femora and trochanters are missing. The tibiæ have spurs and the tarsi small claws (Harling, "Zeitschr. f. Hymen u. Dipt.," 1903, iii.,

p. 208). *Cimbex axillaris.* Antenna replaced in part by tarsus (Kraatz, "Ent. Zeitschr," 1876, xx., p. 377. Figured by Bateson.).

Gastrophilus intestinalis, de Geer. Bedford found eight males and eleven females with abnormal and symmetrical antennæ, which appear to be like imperfect legs in structure. The best example has tarsi, bristles, ? pulvillum, and one terminal claw on each side.

(G. A. H. Bedford. Fifth and 6th Reports of the Director of Veterinary Research: Dept. of Agriculture, Union of South Africa, 1918, pp. 630-632, pl. 8, 14, 15, 16.)

Orthoptera.—Schmit-Jensen, amongst some young stick insects which were cannibalistic in habits, found one with the right antenna replaced by a small leg ending in a tarsus with claws. He amputated the antennæ in others and obtained regeneration, but a small tarsus replaced the lost end of the antenna, the part nearest the head was antennal in structure. He gives good photographs of these abnormal antennæ. (Homœotisk Regeneration af. Antennen hos en Phasmide, *Carausius* (*Dixippus*) *morosus.* "Vid. Med. Kjöbenhavn," 1913, lxv., pp. 113-133.). His experiments suggest that injury is the cause of the condition, but give us no explanation as to why the regenerated part should be like a homologous appendage instead of a simple repetition of the lost part. The late Dr. T. A. Chapman successfully repeated this experiment.

ANTENNA REPLACING LEG.

I do not know of a simple case of substitutional homoeosis of this nature, but one of adventitious homoeosis is on record in a Dipteron.

Dilophus tibialis, Loew. The fore coxa of the right side has a long jointed extra appendage inserted on its anterior face near the distal extremity. It is black except for the bases of the first and second joints, which are red like the coxa. All the joints are covered with short black hairs. There are nine, not ten joints as in the normal antenna, but there is some evidence that the last joint may be two fused together, and the whole is longer than a normal antenna. It is probably a case of reduplication, the extra appendage taking the form of the homologous appendage of another segment. (Wheeler, "Arch. Entwickmech," 1896, iii., pp. 261-268, Fig.: Escherich, "Ent. Nachr.," 1896, xxii., pp. 259-261.)

ANTENNA REPLACING EYE.

I do not know of a case in Lepidoptera, but there are examples in Diptera. *Syrphus arcuatus*, Fall. (Osburn, "Insect Science," 1918, xxvii., p. 67.)

"Squat" mutation of *Drosophila melanogaster.* Amongst other features the head is flat and quite often the eye has a protruding lump which is caused by an extra antenna pushing partly or entirely through. This mutation, which has been lost, was a dominant not sex linked. (C. B. Bridges and T. H. Morgan. "The Second Chromosome Group of Mutant Characters." Publication No. 278, Carnegie Institution of Washington, p. 284). It has been recorded also in a lobster.

Mandible replacing maxilla.

Panesthia sinuata, a cockroach, with the right maxilla replaced by a mandible, is figured by Shelford. ("Proc. Ent. Soc. Lond.," 1907, p. xxxiii.)

The antennæ, eyes, mandibles, maxillæ, and the three pairs of legs, are all homologous appendages belonging to different segments, so that the substitution of any one of them by any other would be a straightforward case of homoeosis. The legs and wings are not considered to be homologous organs, and replacement of one of these by the other is a most surprising and inexplicable phenomenon. The following examples may be extra wings arising near the point of origin of the leg and preventing it from developing, or instances of homoeosis revealing an unsuspected homology between wings and legs.

Wings replacing legs.

Zygaena filipendulae, L. The left hind leg (metathoracic) is replaced by a hindwing, rather small and pale, but normal in other respects. It is described by Richardson, who bred it ("Proc. Ent. Soc. Lond.," 1891, p. x.), and is described and figured by Bateson, who gives a diagram of its neuration ("Materials for the Study of Variation," p. 148), and is also figured by Barrett ("Brit. Lepidopt.," Pl. 60, fig. i.k.).

Parasemia plantaginis, L., with the hind pair of legs replaced by miniature wings. (W. Woodward, "Ent.," 1896, xxix., p. 334.)

There is a doubtful example of the reverse phenomenon in a beetle, *Prionus coriarius*, which is stated to have had the elytra replaced by legs. ("Stett. Ent. Zeitg.," 1840, i., p. 48.)

Pencil of hairs replacing leg.

Cucullia chamomillae, Schiff. This insect had a long brush of yellowish brown hairs arising in place of the right hindleg. They lay along the first abdominal segment. The whole insect is figured, and there is a separate figure of the brush of hairs. The point of insertion was unfortunately damaged. (Przibram, "Arch. Entwickmech," 1910, xxix., pp. 588-614.) It is not clear what appendage homologous with a leg this pencil of hairs represents, if it represents one at all.

Wings replacing patagia.

Gelechia distinctella, Z., male, with six wings. An extra pair of wings, full-sized and symmetrical, arose from the prothorax, and the patagia were absent. It was taken in the Radomer Government of Russia, and described by Tarnani, and regarded as a case of atavism. ("Zap. Inst. Selisk. Choz.," 1906, xviii., pp. 106-134.) Redescribed and figured by H. Schultz in a paper, in which he brings forward arguments to prove that the patagia represent a pair of prothoracic wings. ("Deutsch. Ent. Zeitschr.," 1914, p. 19.) According to Brogniart certain fossil insects possess a pair of prothoracic in addition to the meso- and metathoracic pairs of wings. (Note sur quelques Insectes Fossiles du Terrain Houiller qui présentent au prothorax des appendices aliformes, "Bull. Soc. Philom. Paris," 1890). The six-winged *Gelechia* is to be regarded as an example of substitutional homoeosis.

FOREWING RESEMBLING A HINDWING IN STRUCTURE AND PATTERN, OR VICE VERSA.

This group is less remarkable and commoner than the groups mentioned above. The majority of the examples occur in *Zygaenidae.*

Zygaena occitanica, Vill., bred from a larva by Boisduval. ("Bull Soc. Ent. France," 1853, 3rd ser., i., p. lxviii.) This is figured by Oberthür ("Études," 1896, xx., p. 53, Pl. vii., no. 123).

The right hindwing is replaced by a wing almost identical in structure and colouring with the forewing. The pattern is slightly different, the apex of the wing is more rounded, and the neuration is slightly abnormal.

Zygaena exulans, Hoch., with left hindwing replaced by a forewing. (Wiskott. "Iris.," 1897, p. 391, Taf. xii.) The neuration, which is not quite like that of a forewing, is figured by Przibram.

Zygaena carniolica, Scop. Mödling, 30, vii., 1905, Wagner. Hofmuseum, Wien. Male with left hindwing like a forewing. Figures of the pattern and neuration show that they differ a little from those of a normal forewing. (Przibram, "Arch. Entwickmech," 1910, xxix., pp. 588-614.)

Zygaena filipendulae, L. "Mr. Capper has one with one of the hindwings exactly like a forewing, both in shape and colour, and I believe other similar ones exist." (Mosley, "Nat. Journ.," 1896, v., p. 20.)

Zygaena lonicerae, Esp., with the left hindwing like the forewing in colour and markings. Captured by C. Hewitt, York. ("Ent. Record," 1890-91, i.. pp. 59-60.) The following description probably applies to the same specimen. Right side nearly normal, hindwing a little shortened and quite pointed. The left hindwing is a duplicate of the forewing, being of nearly equal length and having the same rich blue-green colour and red spots. Apex slightly more rounded, and base of costa somewhat arched instead of straight. ("Ent. Month. Mag.," 1895, xxxi., p. 219. Capper Coll.) The specimen in Lord Rothschild's collection is probably the same, but the label is insufficient to identify it.

Zygaena trifolii, Esp. This insect has two wings on the left side resembling forewings, one meso- and one metathoracic, but the forewing on the right side is rather smaller and narrower towards the apex, and there is no hindwing. (Christy, "Ent.," 1894, xxvii., p. 253.)

Zygaena filipendulae, L., with normal wings on the right side, but on the left side two wings resembling hindwings, the foremost occupying the position of a forewing. ("Ent.," 1912, xlv., p. 106.)

Adela viridella, Scop. Franz Hauden, May, 1907. Hofmuseum, Wien. The right hindwing is entirely of the golden-green colour of a forewing, and the long cilia of the posterior border are absent as in a forewing. The frenulum is present. The shape is intermediate between that of a fore- and a hindwing, and the neuration also, but the latter approaches more closely to that of a forewing. Figures of the insect and of the neuration are given by Przibram ("Arch. Entwickmech," 1910, xxix., pp. 588-614).

The following examples differ in that the shape and neuration is normal for a wing arising from that segment of the thorax, from which the abnormal wing arises, with one exception. The substitution of colour and pattern is only partial, and affects only one surface.

Papilionidæ.—*Papilio bianor*, Cram. Captured in China, 1887. There is a patch of the colour and ornamentation proper to the under surface of the hindwing on the under surface of the right forewing. ("Proc. South Lond. Ent. and N. H. Soc.," 1888, pp. 39-40.)

Papilio glaucolaus, Bates, subsp. *melaenus*, Rothsch. and Jordan, male. Storch Coll. Stichel gives a full description and photograph of this insect. On the undersurface of the left forewing a large part of the space between nervures R3, M1, M2, and SM1 (Rothschild and Jordan's nomenclature), is occupied by the markings and colour of a hindwing between the corresponding nervures. Between SM1 and SM2 the oblique black stripe, which should run from the costa without a break, but is interrupted by this abnormal patch, is continued. The red colour of a hindwing has the same relation to nervures in this forewing as in a normal hindwing, and between M1 and M2 the elaborate pattern and colouring of the marginal and submarginal lunules, found between M1 and M2 of a hindwing, are accurately reproduced. ("Berl. Ent. Zeit-chr," 1908, liii., pp. 199-201.)

Parnassius apollo, L., male. South Tirol, 1909. A complete streak, with the colour and pattern of the forewing in the right hindwing. ("Frings, Soc. Ent. Zurich," 1911, xxvi., p. 11.)

Parnassius apollo, L., female. Patches of forewing colour in hindwing. (Frings, ibid.)

Pieridæ.—*Euchloë cardamines*, L., male. An irregular orange patch extending to the margin of the left hindwing, opposite the discoidal area, and a small orange speck near it. (Rye, "Handbook of the British Lepidoptera." Coloured Plate.) It bears the same relation to nervures as a portion of the posterior part of the orange tip of the forewing.

Pieris brassicae, L., female. Brighton, 1898. There is a large area of the white colour of the underside of the forewing, in the middle of the underside of the right hindwing. The edges of the patch are irregular, and there are small specks of white in the deep cream colour of the normal part round the edges of the main area of the white. Both the large black spots of the forewing pattern are reproduced in the hindwing, one between nervures 1b and 2, the other between 3 and 4. Their position is the same in relation to the neuration as the spots in a forewing. The neuration is normal, except that nervure 4 is curved backwards opposite the anterior spot. The upperside is normal and the wing is fully expanded. (Rothschild Coll., Tring Museum.)

Satyridæ.—*Coenonympha pamphilus*, L., with small patches of upperside colouration on the underside of the left hindwing. ("Trans.

Lond. N. H. Soc.," 1915, p. 18.) These are probably patches of the colour of the underside of the forewing, and not the upperside.

Coenonympha pamphilus, with two narrow streaks of upperside colouration, or more probably of the underside colour of the forewing, on the underside of one hindwing. Taken by the late Mr. A. J. Scollick, on Headley Common, May 27th, 1915. I am indebted to Mr. H. B. Williams for the description of this specimen, which he saw captured.

Coenonympha pamphilus, with patch of upperside colouration on the underside of the left hindwing. Maddison Coll. (H. B. Williams, "Trans. City of Lond. Ent. Soc.," 1912-1913, p. 56.) This is probably another example of the underside colour of the forewing on the hindwing.

Coenonympha pamphilus. The colour and pattern of the underside of the left forewing is reproduced over a large part of the left hindwing. The tawny ground colour covers most of the wing as far forward as nervure 3 and three-quarters of the discoidal area. Normal colour and pattern is found between 3 and 4, except at the extreme base. Between 4 and 5 forewing colour and pattern reappears. A narrow ocellus touches 5. It has a white centre and is surrounded by a pale ring, except at the point where it touches the nervure. The normal ocellus occupies the space between 5 and 6 in the forewing, but the black part encroaches on that between 4 and 5, and the pale ring extends halfway between 4 and 5. I think the ocellus in the hindwing represents the posterior part of a forewing ocellus. The only objection to this view is that it has a white centre. The anterior part of the wing is normal. The neuration is normal and the upperside shows the usual colour and markings. The posterior border of the wing is a little crumpled. I am indebted to Mr. A. W. Mera, the captor, for the loan of this specimen. (Plate I., figs. 5 and 6.)

Epinephele jurtina, L. The upperside is normal. There is an additional vein from the discoidal area in the right hindwing. On the underside of this wing a yellow stripe runs across the discoidal area, and over the extra nervure, ending in a large ocellus. The colour and pattern resembles a patch of the upperside of the forewing. It was taken near Oxford in 1877, and is in the Hope Collection. (Westwood, On some unusual Monstrous Insects, "Trans. Ent. Soc. Lond.," 1879, p. 219, Pl. vi.) There is a good coloured plate, which shows that the patch is of *underside* colouration, and a diagram of the neuration. If we take the nervure marked X in the diagram, and regard it as the normal nervure 5 instead of considering it to be the extra nervure, and regard the nervure marked c as the extra nervure, the big ocellus falls into the posterior half of the large space between 5 and 6, and the small normal ocellus of the hindwing falls into the anterior half. They are divided by the extra nervure. In a normal forewing the big ocellus fills the whole space between 5 and 6, and in a hindwing the small ocellus lies in the middle of the space between 5 and 6.

This interpretation of the neuration makes the abnormal ocellus in the hindwing fall into a position homologous with that occupied by the ocellus of the forewing.

Erebia goante, Esp. Dr. Chapman told me that with the late Mr. J. W. Tutt, he took two specimens at Arolla, with upperside markings, in one case freely reproduced, on the underside. Both were destroyed in the journey down. It is probable that they were underside markings of one wing reproduced on the other. It is remarkable how often it has been stated that an upperside patch has appeared on the underside. But in every case examined this has proved to be an error.

LYCÆNIDÆ.—*Rumicia phlaeas*, L., taken by Corbett at Doncaster, September, 1895. There is a large sharply defined wedge-shaped area of the colour and pattern of the underside of the forewing on the underside of the left hindwing, lying between nervures 1b and 4.

It includes half the spot between 1b and 2, that between 2 and 3, and part of that between 3 and 4. The dark submarginal band between 1b and 2, and between 3 and 4, is reproduced, but a wedge of normal hindwing colour extends too far inwards for it to appear between 2 and 3. All the markings occupy positions in relation to the nervures homologous with those occupied by the corresponding markings of a normal forewing. The upperside is normal and the wing fully expanded. The specimen is incorrectly figured by Mosley ("Nat. Journ.," 1898, vii., p. 26), and inadequately described by Tutt ("Brit. Butt.," vol. i., p. 354), and the colour is described as copper, implying that it is a patch of upperside colouration. (Corbett, "Ent. Rec.," 1896, vii., p. 112.) It is now in Mr. P. M. Bright's collection, and he kindly allowed me to examine it. (Plate I., figs. 1 and 2.)

Rumicia phlaeas, L., with a small patch of copper with a black spot in it on the underside. South, I. of Wight. (South, "Butt. of Brit. Isles," p. 153; Tutt, "Brit. Butt.," vol. i., p. 355; "Proc. South Lond. Ent. and N. H. Soc.," 1888, pp. 39-40.) This is probably an example of the colouration and pattern of the underside of the forewing on the underside of the hindwing.

Rumicia phlaeas. Ocellus on underside of left hindwing, like marginal ocelli on underside of forewing. North Devon, 1881. ("Proc. South Lond. Ent. and N. H. Soc.," 1888, pp. 39-40.)

Rumicia phlaeas. On the underside of both hindwings a very large area shows the colour and markings of the underside of the forewings. Both areas are broken up by thin streaks of normal hindwing colour. The upperside and the neuration are normal. The relation of markings to nervures in the hindwings is the same as in a forewing, each spot occupies the interneural space homologous with that occupied by the corresponding spot in a forewing. Taken by A. Quarrington, Purley. Bright Coll. (Plate I., figs. 3 and 4.)

Rumicia phlaeas. Underside of right hindwing marked by red dashes from base to exterior margin. ("Bull. Brooklyn Ent. Soc.," ii., p. 8: Tutt "Brit. Lepidopt.," vol. viii., p. 355.)

HETEROCERA.—ARCTIADÆ.—*Arctia caia*, L. Left upper wing marked with two nearly parallel streaks of the same colour as the underwings, crossing the other colours of the wing from the base to the posterior margin. The underside is not mentioned. (Shepherd, Allis Coll. "Proc. Ent. Soc. Lond.," 1855, vol. iii., n.s., p. 80.)

Arctia caia with extraordinary wedge-shaped mark extending from outer margin to base of left hindwing, and a small spot also on same wing, in colour brown and white. They appeared to have been taken out of forewing and inserted into hindwing. J. A. Clark, Abbott's Wood, Sussex, July, 1892. ("Proc. Ent. Soc. Lond.," 1894, p. xvi.)

Arctia caia, male. In the right hindwing there is a streak of forewing colour, extending almost from the base to the outer margin. It reproduces part of the two outer brown markings, which lie along the posterior border of the forewing, with the white ground between and beyond them. The inner part of the blue-black spot near the anal angle is replaced by the brown colour of the forewing, and part of the posterior and anterior part of the next blue-black spot. A streak of white runs from this spot to the outer margin, separated from the rest of this part of the forewing pattern by a red streak. The middle, posterior, and outer parts of the anterior of the three outer black spots of the hindwing are replaced by brown, reproducing part of the brown marking along the costa of the forewing. The apex of the hindwing is occupied by a reproduction of part of the apical brown marking of the forewing, and between this and the other brown patch is a small white area. The small speck of brown in the outer part of the black spot is connected to the outer margin by a white streak. The underside and neuration are normal. The posterior margin of the wing is a little crumpled. The markings correspond to forewing markings, and appear to occupy homologous positions with regard to nervures. (Rothschild Coll., Tring Museum.)

Arctia caia, with a sprinkling of red in the white bands of the forewings, and also projecting into the brown markings. ("Berl. Ent. Zeitschr.," 1911, lvi., p. (31).)

Arctia caia, with the red colour and the black spots of a hindwing sprinkled over one forewing. The hindwing was normal and there was no deformity. (Frings. "Soc. Ent. Zurich," 1911, xxvi., p. 11.)

Arctia caia. Hindwings Normal. Forewings with dashes of red and some dark spots blue-centred. The coloured figure shows four spots of hindwing pattern in the right forewing, but their position and shape does not quite correspond with that of the hindwing spots. The other side is not figured. Gregson took two larvæ at Pont-y-Mown, North Wales, which produced this and a very similar specimen. ("Nat. Journ.," 1897, vi., p. 28, pl. xviii., fig. 7.) The figure of this, like the other example of homoeosis given by Mosley, may be inaccurate.

Pericallia matronula, L. The right hindwing is narrower than the left, and incompletely expanded near the posterior margin. A strip with the orange and black markings of the hindwing runs along the anterior margin in front of the subcostal nervure and nervure 6, and another normally coloured strip runs along the posterior border. Between these the greater part of the wing is of the brown and white colour of a forewing, the markings being arranged in the same relation to the nervures as in a forewing. The posterior part of each of the three big white costal markings lies just behind the subcostal nervure as it does in the forewing. The posterior part of the white basal patch appears just behind the median nervure, and part of the white spot just behind nervure 2 reappears in the same situation in this hindwing. Scattered over this abnormal part of the wing are small patches of orange and black, each in the position orange and black should occupy in a normal wing. ("Iris.," 1912, xxvi., p. 231, pl. vii.) (Plate I., fig. 8.)

Noctuidæ.—*Mamestra* (*Hadena*) *thalassina*, Rott. The specimen is normal except on the upperside of the left hindwing, where there is a stripe 2mm. wide, running from the base to the outer border, in colour and pattern exactly like part of the forewing. Kabis, Schwartzwald, July. ("Illustr. Wochenschr. f. Ent.," 1899, iv., p. 29.)

Leucania conigera, Fab. The left hindwing is normal in shape, but in colouration and structure in part resembles the upper wing. The coloured figure shows no abnormality in neuration. There is a discal white spot, and a dark submarginal line bent outwards at nervure 4, as in a forewing. Taken by W. P. Smith, near the Welsh Harp, Middlesex, July, 1877. ("Ent.," 1878, xi., p. 169.)

Pachnobia hyperborea, Zett. A radial segment of the hindwing reproduces the rich colour and markings of the forewing. ("Ent. Record," 1910, xxii.. p. 266.)

Taeniocampa gothica, L. This is described quite incorrectly ("Proc. South Lond, Ent. and N. H. Soc.," 1915-1916, p. 92). The specimen is a male, taken by the late Mr. Stallman at Oxshott, April 17th, 1911. His brother kindly allowed me to examine it. There is a strip on the upper surface of the left hindwing occupying most of the space between nervures 1 and 2, in which the dense scaling, colour, and pattern of a forewing between the two corresponding nervures is accurately reproduced. The neuration and the underside are normal. The wing is of the shape of a hindwing, of full size, and not deformed or crumpled. (Plate I., fig. 7.)

Neuronia cespitis, Fab. On the upperside of the right hindwing the whole central part, from base to outer margin, resembles a forewing in colour and pattern. Cells 1a and 1b, and 7 and 8, are whitish, like a normal hindwing. The shape of the wing is that of a hindwing, and it is fully expanded. Taken near Carlsbad, 1900. (O. Schultz, "Berl. Ent. Zeitchr.," 1901, xlvi., p. 15, fig.)

Catocala nupta, L. Streaks of red of the same colour as that of the hindwings on the forewings. Howard Vaughan Sale. ("Nat. Journ.," 1898, vii., p. 82.)

Zygaena minos, Schiff., with an additional wing on the left side, inserted between the two normal wings, is considered by Przibram to be an example of adventitious homoeosis because the colour is that of a forewing, but the structure is more like that of a hindwing. I have included it in the list of examples of an extra wing with the reference to Rogenhöfer's description and figure.

Westwood thought that his *E. jurtina* was an example of extra wing formation, but a study of the examples recorded more recently, makes it evident that they are cases of homoeosis. In those most carefully described the pattern proper to an area of one wing is reproduced in the homologous area of the other wing, and on the same surface.

It is possible that incomplete or inaccurate descriptions and drawings account for any exceptions. In the genus *Zygaena* there is an almost perfect reproduction of the shape and neuration of a forewing in the aberrant hindwing, as well as its colour and pattern, or vice versa. In *Adela* the shape and neuration are intermediate, but as in *Zygaena* the whole of the wing is altered.

In all the others the shape and, with one exception, the neuration are unaltered, and the colour and pattern are only changed over a part of one surface of the affected wing or wings. Five are bilateral. In very few is the abnormal wing small or crumpled, but this does not disprove the possibility that they all originate in some small injury, and are really examples of homoeotic regeneration. Even if this is so, we cannot explain why in rare instances a part should be regenerated in the likeness of an homologous part instead of its own likeness.

Of the 40 collected records seven occur in the genus *Zygaena*, one in the *Tineidae*, four in the *Papilionidae*, two in the *Pieridae*, seven in the *Satyridae*, five in the *Lycaenidae*, eight in the *Arctiadae*, and six in the *Noctuidae*. Though the numbers are small the frequency of this anomaly in some families and its absence in others must be more than a mere coincidence. This is still more striking when we realise that half the known cases have occurred in five species, seven in *Arctia caia*, four in *Coenonympha pamphilus*, five in *Rumicia phlaeas*, and two each in *Parnassius apollo* and *Erebia goante*.

HOMOEOSIS IN A LARVA.

Hart records a larva of *Chaerocampa elpenor*, L., with three well-marked eye spots on each side instead of two, and with a rudimentary caudal horn. He does not state whether the extra pair occurred on the segment anterior to the first pair or posterior to the second pair. ("Irish Naturalist," 1918, xxvii., p. 172.)

ERRORS OF METAMORPHOSIS.

(1) Delayed or incomplete metamorphosis. The appearance of larval characters in the pupa or imago, or pupal characters in the imago.

(2) Precocious metamorphosis or Protethely. The appearance of pupal or imaginal characters in the larva or imaginal characters in the pupa.

(1) Dr. Chapman by feeding larvæ of *Triphaena comes*, Hb., on unsuitable food (arbutus) obtained a larva, which instead of pupating continued as a larva for a further instar, grew to great size and then died. This species is usually constant in the number of ecdyses, and had a critical examination been made pupal characters might have been found. He repeated the experiment and some larvæ reached full growth and then prepared for a further ecdysis. Most of them failed

to cast their skins, and those which succeeded refused food. All of them showed some pupal characters in the antennæ, maxillæ, eyes and prolegs. ("Ent. Month. Mag.," 1896, xxxii., pp. 54-80.) They are to be regarded as pupæ with larval characters rather than larvæ with pupal characters.

Powell records a parallel case in *Papilio alexanor*, Esp. One larva passed into a sixth stage instead of pupating. The head and prolegs were very large and the mouth parts abnormal. It fed with difficulty, was clumsy in its movements, and finally died. It was not examined critically for pupal characters. ("Ent. Record," 1904, xvi., p. 68.)

Chapman describes and figures a pupa of *Hastula hyerana*, Mill., with jaws of larval pattern, but with a rough surface instead of the polished surface of the normal larval jaws. This is now in the teratological collection of the British Museum. ("Trans. Ent. Soc. Lond.," 1907, p. 173, pl. xii.)

Larva with pupal antennæ. (Lindner, "Zeitschr. f. Wiss. Insekt. Biol. Berlin," 1915, xi., p. 244.) This paper is not available.

Clément describes a pupa of *Smerinthus* (*Mimas*) *tiliae*, L. Taken at Issy-les-Moulineaux, in 1896, which had a well-developed caudal horn on the 12th segment. The imago bred from it had a long bristle-like process in the same position. He also mentions a pupa of *Deilephila euphorbiae*, L., with a similar caudal horn, but there was no trace of this structure in the imago. He figures both the pupa and imago of *S. tiliae*. ("Bull. de la Soc. Ent. de France," 1898, xiii., p. 268.)

M. Muller gives figures and a long description of a moth which is evidently *Psilura monacha*, L., found sitting on a plant of *Epilobium montanum*, on June 28th, 1762. There was a triangular brownish area on the front of the head, which was transparent, and through which one could see a clear liquid in continual movement. The head differed slightly in other respects from a normal larval head. He states that it was able to move its mouth parts. It laid a number of infertile eggs, and died on August 6th. If the mouth parts were really mobile this must be regarded as a genuine case of larval characters in an imago. ("Mém de Mathém et de Phys. présentés à l'Acad. Roy. des Sciences de Paris," 1774, vi., pp. 508-511.)

(2) Jones describes and figures a larva of *Melanippe montanata*, Schiff., one of twelve, which grew much faster than the others, and in its last instar was possessed of imaginal prolegs and pectinated antennæ. The latter were of gelatinous consistency, and as they began to shrivel and the larva appeared moribund, it was killed and preserved. ("Ent.," 1883, xvi., p. 121.) Harrison describes a larva of the hybrid *Oporabia dilutata* ♂ × *O. autumnata* ♀. It was one of a brood, fourteen of which in their penultimate instar, instead of moulting normally, spun silken pads and remained motionless for a fortnight. Thirteen died owing to interference by other larvæ caged with them, but the fourteenth, which had been isolated, moulted after five weeks and showed imaginal characters. It had a very small head with many jointed antennæ, eyes with both imaginal and larval characters, and four rudimentary wings with vestiges of imaginal neuration, one 3mm.

long and three 1·75mm. long. The legs showed indications of imaginal structure. ("Journ. of Genetics," 1920, ix., no. 3, p. 268.)

Cesare Majoli, in 1813, had some larvæ of *Bombyx mori*, L., which, after the fourth ecdysis, had the thorax partly larval and a larval body, but the head was small with small black eyes and imaginal antennæ, and from the thorax sprouted rudimentary wings. ("Proc. Ent. Soc.," 1879, pp. 222-228.)

In 1879 a specimen thought to be *Orgyia antiqua*, L., was exhibited, which showed a mixture of larval, pupal and imaginal characters, but no adequate description is given. Winneguth records six abnormal larvæ of *Dendrolimus pini*, L. ("Insektenbörse," 1902, xxxvii., pp. 290-291.) One pupated and a small male emerged. These larvæ had imaginal characters in the antennæ, maxillæ, and prolegs. Kolbe gives a full description with numerous figures. ("Allgem. Zeitschr. f. Ent.," 1903, viii., pp. 1-9 and 25-30.)

Dewitz experimented with larvæ of *Pieris brassicae*, L., injecting them with acetic acid, 1 in 100, or strong sodium chloride. After one injection he had many larvæ, which did not pupate, but reached an intermediate stage between larva and pupa. They had the form of the larva, but the abdomen approximated to that of the pupa. The head and thorax wholly larval. One lived for a fortnight in this condition. I am not clear whether this is an example of retarded or precocious development. ("Arch. f. Anat. u. Physiol, Leipsig, Physiol. Abt.," 1902, p. 327.)

The phenomenon of anticipation has been noted in the case of minor characters by Harrison and Denso, in hybrid Sphingid and Bistonine larvæ. ("Zeitschr. f. Insektenbiol.," 1908, iv. (xiii.), pp. 128-135, 170-176, and 201-208.) The whole subject is discussed by Kolbe and Peyerimhoff.

It is much commoner in Coleoptera.

Larvæ with wings have been found in *Tenebrio molitor* (Heymons, "Sitz. Ber. Ges. Nat. Freunde," 1896, pp. 142-144), *Anthrenus varius* (Busck, "Proc. Ent. Soc. Washington," 1897, iv., p. 123), *Dendroides canadensis* (Riley, "Ent News. Phila.," 1908, xix., no. 9, pp. 136-137), *Malthodes* (Peyerimhoff, "Bull. de la Soc. Ent. de France," 1911, p. 327), *Cantharis* (Trägårdh, "Fauna och Flora," 1912, pp. 245-255), *Telmophilus typhae*, Fall. (Kemner, "Ent. Tidskrift," 1914, xxxv., pp. 86-95), and *Photurus pennsylvanica* ("Psyche," 1914, xxi., p. 126).

Arendsen Hein states that in almost every large culture of *Tenebrio molitor* larvæ with wings occur, but only in the case of those with an abnormally long life. ("Journ. of Genetics," 1920, x., no. 3, p. 229.)

Although Coleoptera, like Lepidoptera, are holometabolous insects, their wing development is less complicated, and the appearance of rudimentary wings in their larvæ is less remarkable.

An abnormality which I cannot explain or classify is Chapman's pupa of *Pieris brassicae*, L., which had a double pupal skin. The inner skin was thinner but normal in structure, even to the possession of cremasteric hooks. ("Ent. Month. Mag.," 1917, 3d ser. iii., pp. 196-197, plate.)

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[illegible] ([illegible])

Although failure to complete an ecdysis is in no way comparable to a true error of metamorphosis, it is convenient to mention this next.

A larva sometimes fails to cast the old covering of the head, and with the new mouth parts imprisoned dies of starvation. Chapman figures an example in *Amorpha populi*, L. ("Ent.," 1906, xxxix., p. 217).

Sometimes the pupa retains the old covering of the larval head. Richard Lang figures a pupa of *Sphinx ligustri*, L., with a larval head and the three pairs of larval prolegs still attached ("Allg. Zeitschr. f. Ent.," 1904, ix., p. 224). I have a pupa of *Epinephele tithonus* with larval head. Numerous instances of imagines with larval heads are on record, and some have been dissected to show the skin of the pupal head, and the head of the imago with rolled up antennæ within.

Wesmael describes a case in *Limenitis populi*, L., which he dissected, and figures it ("Bull. de l'Acad. des Sc. Brux.," 1838, iv., p. 359). Kolbe gives examples in his paper on protethely. Many are cited in "Proc. Ent. Soc. Lond.," 1837-40, ii., p. lxix., and "Trans. Ent. Soc. Lond.," 1879, pp. 222-228, including examples in *Bombyx mori*, *Zygaena exulans*, and *Mimas tiliae*. Two examples in *Z. lonicerae* and *Z. trifolii* are mentioned in the "Entomologist's Record," 1890-91, i., p. 174. One in *Pyrameis atalanta* and another in *Gastropacha quercifolia* are recorded in the "Entomologist," 1870-71. Last year I bred a *Pyrameis atalanta* in this condition.

A specimen of *Aglais urticae* with larval head was caught flying in a "normal" way by J. Clark ("Ent.," 1872-73, vi., p. 221). Another is recorded by Speiser ("Ill. Zeitschr. f. Ent.," 1899, iv., p. 155), and one in *Limenitis sibylla* by Schnepf ("Intern. Ent. Zeitschr. Guben, 1909, iii., p. 160).

REVERSED POSITION IN PUPA.

Saturnia paronia, L., a fresh imago was found with the anal end protruding from the split cephalic end of the pupa case inside a well-formed cocoon. (Speyer, "Stett. Ent. Zeitung.," 1860, xxi., pp. 369-371.)

Deilephila euphorbiae, L. A specimen in the same condition as the last is described and figured. (Bauer, "Allg. Zeitschr. f. Ent.," 1902, vii., p. 110.)

Bombyx mori, L. Two specimens, a male and a female, were found firmly fixed in a single pupa case, with the heads towards the anal end of the pupa case. The female lived ten days and laid eggs, the male lived twelve days. They are stated to have been the product of a single larva of normal size and appearance, one of a family of six, from which seven imagines were produced.

The specimen was shown at the Entomological Society, but no explanation was offered. The emergence of two imagines from a single larva seems incredible. (E. Kay Robinson, "Ent.," 1881, xiv., p. 193, fig. .)

The reversal inside the pupa case during development is a genuine one. Newstead reported it in a fly, *Auchmeromyia luteola*, and more recently Macarthur found six *Calliphora erythrocephala* reversed in the puparium, with the head of the imago towards the posterior spiracles. The pupal case was ruptured at the usual site, but the flies could not free themselves. They were found amongst several thousand normal ones. In 500 pupæ dissected later one was found lying reversed inside a pupa case, which was unbroken before dissection. ("Journ. R.A.M.C. Lond.," 1921, xxxvi., pp. 232-233.)

AXIAL DUPLICITY.

A single fertilised ovum sometimes gives rise to two individuals, owing to complete separation of the two first hemispheres of a dividing egg. In mammals this phenomenon is not uncommon, and the two individuals formed in this way are known as homologous or identical twins. In insects I know of no case in which two larvæ have hatched from one egg. Division may be incomplete and affect the anterior or posterior part of the embryo. Instances of this are well known in vertebrates, and are commonly known as double monsters.

Loeb has shown that the temporary immersion of the eggs of the sea urchin in lime-free sea-water results in the production of 90% of twins. Centrifugalisation of duck's eggs causes the production of a high percentage of double monsters.

Abnormal physical conditions causing delay at an extremely early period of development appear to be the true cause of this form of twinning and of double monsters. The conditions in the egg stage of Lepidoptera and other insects must be unfavourable to their production. I know only four records in Arthropods, two of which refer to insects. One of these is a gnat larva (*Chironomus*) with two heads and with the anterior part double to the fifth segment (Weyenburgh, "Stett. Ent. Zeitung.," 1873, xxxiv., p. 452, fig.). The other is a larva of *Thaumatopoea pinivora*, Tr., found wild at Swinemunde. The hind part branched into two normal sized extremities, each with a normal pair of hind claspers. It pupated successfully and produced a gynandromorphous imago, male on the left side and female on the right. It is recorded in Schultz' list of gynandromorphs of Palæarctic Lepidoptera. ("Ent. Zeitschr. Stutt.," 1907, xx., p. 242.)

ABNORMAL SEGMENTATION.

SPIRAL SEGMENTATION.—This phenomenon is well known in Annelids, and is discussed by Bateson in his "Materials for the Study of Variation," p. 158. In the Teratological Collection of the British Museum there is an example in a larva of *Hipocrita jacobaeae*, L. The first six segments are normal, the seventh and eighth form a continuous spiral from right to left, and the rest are normal. It is labelled Champion, 1918. I believe there is a record of two or three similar specimens in this species, all taken at the same time. There is also a record in *Deilephila* (*Celerio*) *euphorbiae*, L. The fourth, fifth, and sixth abdominal segments were fused into a continuous spiral in the pupa and imago, both of which are figured. (Christeller, "Ent. Mitt.," 1917, vi., p. 15.)

Amongst other anomalies of segmentation in the larva of *Tenebrio* *molitor*, Arendsen Hein figures an example of spiral segmentation ("Journ. of Genetics," 1920, x., p. 230). A second example in Coleoptera is in *Stenocorus fasciatus*, F., with three segments in the spiral. (Scholz., "Ill. Zeitschr. f. Ent.," 1900, v., p. 298.)

Fusion or defect of segments.—Larva of *Bombyx mori*, L. The seventh and ninth segments met on the dorsum, the eighth was deficient and formed a swelling on each side. There was a depression at the point of contact of the seventh and ninth. The third clasper on the left side was absent and the corresponding spiracle small. The larva died before pupation. (Bassi, "Ann. Soc. Ent. France," 1852, x., 2nd s., p. ix.) Larva of *Catocala unijuga*, Walk. Fusion of second and third abdominal segments on the right side, so that there were three claspers on the right and four on the left. (Dadd, "Berl. Ent. Zeitschr.," 1910-1911, lv., p. (23).)

Hastula hyerana, Mill. Pupa with 4th and 5th abdominal segments fused. (Chapman, quoted by Christeller, "Ent. Mitt.," 1917, vi., p. 16.)

In Hein's experiments with *Tenebrio molitor*, segmental defects did not appear to be hereditary. In *Drosophila*, on the contrary, one segmental defect behaved as a sex-linked dominant, but only appeared if the environment of the larvæ and pupæ was moist. Bred in a dry environment all appeared normal, but the next generation bred in a moist atmosphere showed the abnormality again.

Abnormal Tubercles.

Dr- Chapman and Mr. Bacot on several occasions have met with larvæ with an abnormal arrangement of tubercles on one side of a segment, chiefly in *Arctianae*. I can find only two recorded examples of this kind of defect.

Larvæ of *Orgyia antiqua*, L. On the second segment on the left side the tuft of black hairs was half the length of that on the right, but there was a short extra tuft not present on the right side at all. (Bird, "Ent. Record," 1905, xvii., pp. 311-315.)

Hybrid larva, *Philosamia ricini* × *P. cynthia*, with no infraspiracular tubercle on the left side of the segment. (Hawkes, "Journ. of Genetics," 1918, vii., pp. 135-154.)

I have a preserved larva of *Asphalia flavicornis* in its last instar, taken near Sheffield in July, 1902, with a unilateral defect. On the left side of the ninth segment the black subdorsal spot is absent, and the associated oval white spots, with their central tubercle, except the one anterior to the black spot, are missing. The spiracle on the left side is normal, but the crescentic black spot above it is reduced to a circular dot, and the hair above is thinner and shorter than usual. There is no scarring, and the right side of the segment is normal.

These unilateral defects are probably developmental, but like the defects of segmentation, not hereditary. Defects in the midline are—

Larva of *Triaena psi*, L., with unusual development of fleshy horn (Moore, "Ent. Record," 1908, xx., p. 243).

Larva of *Sphinx ligustri*, L., with a small chitinous plate replacing the horn (Schultz., "M. Wochenschr. f. Ent.," 1898, iii., p. 359).

Pupa of *Celerio euphorbiae*, L., with cremaster like a modified larval horn (Rangnow, "Intern. Ent. Zeitsch, iv., 50, p. 276)."

HEREDITARY ABNORMALITIES OF TUBERCLES.

Amongst hybrid larvæ of *Philosamia ricini*, Boisd., male, × *P. cynthia*, Drury, female, some had no tubercles, and others had reduced tubercles.

F. 2 larvæ, with reduced tubercles, behaved as mendelian recessives. (Hawkes, "Journ. of Genetics," 1918, vii., pp. 135-154, fig.)

Bombyx mori, L. A number of larvæ were bred which had no caudal horn. Mendelian inheritance was not proved. (Kellogg, "Inheritance in Silkworms," i., Stanford University, 1908.)

Smerinthus ocellatus, L. Broods of larvæ without caudal horns are reported by Kuhlmann and Krecker. In the latter case they were noticed to be hornless on emerging from the egg. ("Ent. Zeitshr. Guben.," 1900, xiii., p. 144 and 154.)

Bombyx mori, L. Larvæ with knobs which were paired evaginations of skin in the subdorsal line. These first appeared after the third ecdysis, were fully developed in the last instar, but were still visible in the pupa and imago. Mendelian segregation occurred. (Tanaka, "Genetic Studies in the Silkworm, Journ. Coll. Agricult., Tohoku Imperial Univ. Sapporo," June, 1916.)

ABNORMAL NEURATION.

Abnormal neuration is common in the case of extra wings, and an example of an extra nervure has been mentioned in connection with homoeosis. It is also met with as an independent abnormality. Morgan found that cases of symmetrical defect or excess of neuration in the fruit fly were hereditary, and this may be the case in Lepidoptera also. I know of no experimental evidence on this point.

SYMMETRICAL EXCESS.

Papilio merope, Cram., with additional cell symmetrically placed in both forewings. (Trimen., "Proc. Ent. Soc. Lond.," 1873, 21, p. ii.)

Parnassius clodius, Ménétries. Similar specimen. (Murray, ibid, 1872, 33, p. iv.)

SYMMETRICAL DEFICIENCY.

Papilio machaon, L., with the second discoidal nervure in both fore- and hindwings missing, causing the absence of one submarginal lunule in all the wings. ("Proc. South Lond. Ent. Soc.," 1895, p. 47.)

Pararge megaera, L., male. Second nervure of median vein is wanting in all four wings. In forewings, where vein should cross, is an extra ocellus. In hindwings the two ocelli, which should be separated by the vein, are fused and elongated towards one another. (Webb, "Ent.," 1889, xxii., p. 289, fig.) Also figured by Bateson. ("Materials for the Study of Variation," p. 301.)

Melitaea aurinia, Rott. Six nervures almost symmetrically deficient on either side, causing alteration of submarginal black lunules. Janson, Kent. ("Proc. Ent. Soc. Lond.," 1914, p. lxxx.)

Saturnia pavonia, L. Ocellus in both forewings replaced by yellow dash, and at least one nervure deficient. Bred by Barlow. ("Proc. Ent. Soc. Lond.," 1851, i., p. 100.) The male figured by Bateson bred from a larva found on sallow, in Sawston Fen, Cambridgeshire, and by Bond ("Ent.," 1877, p. 1) is probably the same specimen. It is mentioned in Humphrey's "Brit. Moths," p. 20. In other eyeless Saturnias the neuration is not mentioned.

Melitaea aurinia, Rott. A nervure missing in each hindwing, probably the seventh, or possibly the sixth. (Bright Coll.)

Eucosmia immundana, Fab., with veins seven and eight stalked in both forewings in two specimens, in one forewing in one.

E. tetraquetrana, Haw., and *E. crenana*, Hubn., single specimens of each with the same altered neuration in both forewings. (Durrant, "Ent. Month. Mag.," 1910, xlvi., p. 35.)

Dicranura felina, Butl. Veins three and four becoming coincident in the forewing on each side. Almost symmetrical. The markings are altered by the union of nervures, (N. H. Museum.)

Batesia hypoxantha, G. and S. Subcostal nervure of hindwing united by a short bar to upper discoidal nervure. Position of bar different on the two sides. (Lathy, "Proc. Ent. Soc. Lond.," 1904, p. 67.)

Asymmetrical Neuration.

Papilio thoas, L. Left hindwing with abnormal neuration. Subcostal nervure bifurcated a little beyond cell, sending extra branch to posterior margin. Seven instead of six ochreous spots in discal band and an extra submarginal lunule. Right hindwing normal. ("Proc. Ent. Soc. Lond.," 1890, p. ii.)

Papilio americus, Koll. (*sadalus*, Lucas). Radial nervures absent in right hindwing; precostal nervures dissimilar and abnormal. Submarginal spots abnormal. Tail much shorter than in the other wing. ("Proc. Ent. Soc. Lond.," 1881, p. xxviii.)

Pyrameis cardui, L. Small left hindwing with abnormal neuration. Nervures three, five and six do not reach the margin; four branches twice and thus reaches the margin at three points. Two pairs of spots coalesce. (C. Nicholson, "Ent. Record," 1893, iv., p. 189.)

Zemeros flegyas, Cram. Nervure eleven branching out of twelve in forewing. (Brit. Mus. Coll.)

Pyropsyche moncaunella, Chapman. Missing nervure partially represented in two specimens. (Chapman, "Proc. Ent. Soc. Lond.," 1904, p. 99.)

Parnassius apollo, L. (Bryk., "Parnassius Apollo," Berlin, 1915, p. 104.)

Non-union of paired median structures.

Pupa of *Sphinx ligustri*, L., with tongue sheath bifurcate. (Bond, "Proc. Ent. Soc. Lond.," 1852-1853. ii., p. 4.)

Pupa of *Sphinx ligustri*, with double proboscis; the two mandibles had not united to form a single proboscis, but were divaricated. (Kraatz, "Deutsch. Ent. Zeitschr.," 1880, xxiv., p. 345, fig.)

Pupa of *Sphinx ligustri*, with double proboscis sheath and other defects. (Fromholz, "Berl. Ent. Zeitschr," 1888, xxxii., p. 229, fig.)

Pupa of *Sphinx* (*Hyloicus*) *pinastri*, L., with double proboscis sheath, each half bowed outwards, forming a ring (H. Gauckler, "Ill. Wochenschr. f. Ent.," 1896, i., p. 563, fig.)

Pupa of *Smerinthus ocellatus*, L., with double proboscis sheath, the two halves slightly divergent. No other abnormality. (Christeller, "Ent. Mitt.," 1917, vi., p. 99, fig.)

Imago of *Vanessa io*, L., with double proboscis. From time to time it tried to use both, and one or other unrolled. Apparently each could be moved independently. (Maréchal, "Rev. Ent. Soc, Namuroise," 1902, p. 49.)

Arrest of Development.

Manduca atropos, L. Imago with abnormally long proboscis. Chapman explains this as due to an arrest of development. The proboscis in this species is long at first and then shrinks during the later part of the pupal period. The shrinkage has not occurred in this specimen. ("Ent. Rec.," 1902, xiv., p. 129.)

Plebeius argus, L. (*aegon*, Schiff.). Male with tarsus divided into three joints instead of having all the joints and claws fused without trace of articulation. (Chapman, Spain, "Proc. Ent. Soc. Lond.," 1909, p. xv.)

Flint reports that in a brood of larvæ of *Endromis versicolor*, L., which died without eating, the mesenteron and gnostodeum had failed to join, so that there was no continuous lumen to the gut. ("Entomologist," 1901, p. 363.)

Duplication of Parts.

Bateson finds that in insects extra appendages, with the exception of wings, are arranged in the following way. They may arise from the body near the part repeated, but much more frequently they occur as outgrowths from an appendage. The parts found in an extra appendage are those parts which in a normal appendage lie peripheral to the point from which the extra appendage takes its origin. Extra appendages are double, or when single show that they are fused double appendages. The long axes of the double appendage, and of the two extra appendages, are in one plane. One of the two extra appendages is nearer to the axis of the normal appendage, and the other more remote from it. The nearer of the two is in structure and position formed as the image of the normal appendage, in a plane mirror placed between the normal appendage and the nearer one, at right angles to the three axes. The remoter appendage is the image of the nearer in a plane mirror similarly placed between the two extra appendages. The nearer of the two is thus structurally an appendage of the opposite side of the body.

The cause of extra appendages of this nature appears to be a slight injury. Tornier has shown that a cut into the posterior limb bud of a frog causes the outgrowth of a pair of extra limbs arranged in this way. ("Arch. f. Entw'm.," 1905, xx., p. 76, and "Sitzungsb. d. Ges. Naturf. Berlin," 1907, p. 41.) Chapman bred an *Ocneria dispar*, L., with two tibiæ after crushing the larval leg. ("Ent.," 1901, xxxiv., p. 30.) This extra tibia was presumably a fused double extra tibia, one half being a mirror image of the other, such as is obtained by half immersing a tibia in mercury.

In this connection one must mention the race of *Drosophila ampelophila* with supernumerary legs. Sometimes several legs or parts of a leg are doubled, and the doubling is of the character described above. Bred in a temperature of 10°C., Miss Hoge found that the inheritance was Mendelian, but at normal temperatures few flies showed the abnormality. This can be explained by supposing that the limb buds of this race are peculiarly liable to injury by cold. ("The Mechanism of Mendelian Inheritance," Morgan, Sturtevant, Muller and Bridges, pp. 41 and 42.)

ABSENCE OR REDUCED SIZE OF PARTS.

Newport has shown that clean amputation of a part during the developmental period may lead to its complete absence or regeneration of the part may take place, but though perfect, the regenerated part is smaller than the normal. ("Proc. Ent. Soc. Lond.." 1845-47, iv., p. 97.)

De Kerville has amplified Newport's work. By injuring the legs and antennæ in a number of species of Lepidoptera, he has obtained partial or complete regeneration with normal or abnormal form, but with reduction of size. He figures the leg of *Papilio podalirius*, L., small and incomplete, regenerated after injury to the larva during the fourth or fifth instar. He has obtained similar results in the case of wings, and figures a *Pieris brassicae*, L., with a very small left forewing, caused by injury to the median part of the thorax of the pupa, and an *Yponomeuta malinella*, Z., with extremely small wings on the right side, produced by lightly cutting the wings at the base in the pupal stage, six days before emergence. ("Experiences teratogéniques sur différentes espèces d'insectes," Henri Gadeau de Kerville, "Le Naturaliste," 1890, p. 114). Little is known of the kind of injury which operates in nature. There is a record of an *Acronicta psi*, L., from the larva of which two small larvæ of an ichneumon emerged, and which produced an imago with one hindwing missing. ("Ent. Month. Mag.," 1864-65, i., p. 118.) Harding states that he has met with dwarfing or absence of wings on one side in *Melitaea aurinia*, Rott., *M. cinxia*, L., and *Aglais urticae*, L., after parasitism by a few larvæ of *Microgaster*, instead of the usual large number. He also refers to a moth with one hindwing missing, bred from a larva which had had an injury to the legs. This was reported in the "Field." ("Ent.," 1883, xvi., p. 257.)

DUPLICATION.—LEG.

Zygaena anthyllidis, B. This specimen has three tarsi on the metathoracic leg on the left side. There is an extra pair arranged in secondary symmetry. (N. H. Museum Coll.) Chapman gives description and figure. ("Proc. Ent. Soc. Lond.," 1914, p. lxxxiv., and "Ent. Record," 1915, xxvii., p. 93.)

Cosmotriche potatoria, L., male, with double tarsus on left foreleg. The tarsi were smaller with fewer scales than normally, but had perfect claws. ("Ent. Mo. Mag.," 1899, xxxv., p. 270.)

Catocala nupta, L., with double tarsus on left foreleg. No evidence that either is a fused double structure. Figure and description. ("Trans. Ent. Soc. Lond.," 1907, p. 173.)

Parnassius apollo, L. Two tarsi an left foreleg, both a little shorter than a normal tarsus. (Bleuse, "Bull. de la Soc. Ent. de France," 1900, p. 52.)

Plusia iota, L., male, with extra leg between left anterior and middle legs. In form like a front leg, but with tibia a little longer and tarsus a little shorter. England. (Ibid.)

Smerinthus ocellatus, L., with complete additional hindleg on left side. The left leg was ankylosed and useless. It had a femur longer than usual, a tibia, and five-jointed tarsus. The pupa had a bulge on the ventral surface. ("Illust. Wochenschr. f. Ent.," 1897, ii., p. 632.)

Ocneria dispar, L., male, very small incomplete extra tarsus on hindleg. ("The Gypsy Moth, Report of Massachusetts Board of Agriculture, 1896.," Forbush and Fernald, pl. li., fig. 8, p. 341.)

Cosmotriche potatoria, L. In the Tring Museum is a preserved larva with an extra pair of claspers, which lie above the second clasper on the left side. They appear to be in secondary symmetry. The specimen is labelled Hanwell, Middlesex, 1892.

Duplication of legs is quite common in Coleoptera, but it is probably overlooked in Lepidoptera.

DUPLICATION.—ANTENNÆ.

Zygaena. Several records of specimens with three antennæ. (Illustr. Wchenschr. f. Ent.," 1897, ii., p. 632.)

Zygaena lonicerae, Esp., with four antennæ. Bred Flamborough. (C. Couldwell Hall, "The Naturalist," 1919, xliv., p. 182.)

Z. filipendulae, L. The right antenna separated near the base into two well built antennæ. The left was split near the middle into two for a length of about 3 or 4 mm. and was joined together again at the tip. Both appear to have been partially fused double antennæ. Bred from pupa. Korn. Danzig. ("Ent. Zeitshr. Guben," 1892, V., p. 152.)

Leucania pallens, L., with two well developed antennæ on one side and one of double the normal thickness with a bifid extremity on the other. ("Ent. Record," 1914, xxvi., p. 127.)

Doleschallia amboinensis, Stgr., female, with two antennæ on the right side superposed, the lower one a little the shorter. (Oberthür, "Bull. de la Soc. Ent. de France," 1900, p. 53.)

Crambus alpinellus, Hb., with three antennæ. Staudinger Coll.

("Illustr. Wochenschr. f. Ent.," 1897, ii., p. 632.) (Giard, "Bull. Soc. Ent. France," 1900, p. 53.)

Olene leucophaea, Abbot and Smith. Male, with two antennæ on each side. In the figure the extra antennæ are depicted as arising from a different point from the normal ones, and show no evidence of being double structures. (E. J. Smith Coll., "Psyche," 1904, ii., p. 113, pl. x.)

Conistra (*Cerastis*) *ligula*, Esp. Specimen in N. H. Mus. labelled Hayward, Repton, 8.10.06. There are two antennæ on the left side, arising from distinct but contiguous bases. They are about two-thirds the normal length. The anterior one is thinner and takes origin from a point above and in front of the normal position. The surfaces covered by pale scales are turned slightly towards one another, but one does not appear to be the mirror image of the other. There is no evidence of double structure in either, but the antennæ in this species show no decided structural difference in the characters of the anterior and posterior surfaces. So that the microscopical examination does not prove that one is not a fused double antenna, consisting of two anterior halves or two posterior halves. The dorsal and ventral surfaces are normal in both. ("Ent.," 1906, xxxix., p. 294.)

Coscinocera hercules, Misk., male. Saturniid moth. On the left side one antenna, on the right two, the first in the normal position a little shorter than the left, the second slightly behind, well developed, but also a little shorter than the normal. Both are fully pectinated. The head appears enlarged on the right side. Captured by Dodd, Queensland. (Oberthür, "Bull. Soc. Ent.," 1912, p. 369.)

Saturnia pavonia, L., male. A small third antenna arises, not from the root of the other but quite 2mm. away and above, directly from the face. Bred from a Dalmatian larva. (Windhorst, "Ent. Zeitschr. Frankfurt," 1914-1915, xxviii., p. 3, fig.) This is remarkable in that the normal antenna is not reduced in size. There can be no doubt that this is a genuine example of an independent extra appendage.

Duplication.—Palpi.

Euprepia purpurea, L., with three palpi, not with an extra pair of palpi as Bateson suggests. Gynandromorph, right side male, left side female. (Freyer, "Beiträge. z. Schmetterlingskunde," 1845, v., p. 127, Taf. 458, fig. 4.)

Duplication of Wings.

In the few cases studied by Bateson there was no example conforming to the rule that extra parts are double and in secondary symmetry. With a large series of records three main groups can be separated.

(1) Repetition of a wing or part of a wing, the extra wing being in structure a wing of the same side as the normal wing. Examples of this kind may be regarded as simple meristic repetitions.

They may be either fore- or hindwings, and may be in front of, behind, above, or below the normal wing. Both wings may be perfect and of full size, but more often they are small and imperfect, especially the extra wing.

(2) Repetition of a wing or part of a wing, which in structure belongs to the opposite side of the body to the normal wing. In other words, the extra wing is a mirror image of the normal wing. There are four possible positions for such an extra wing; in front with its costa opposed to the costa of the normal wing, behind with its hind margin opposed to the hind margin of the normal wing, above with its upper surface facing ventrally, opposed to the upper surface of the normal wing, or below with its under surface facing dorsally, opposed to the under surface of the normal wing. In the first position the costa of the extra wing may be united to the costa of the normal wing, or the two wings may be quite separate. The second position seems to be rarer, and in the only example I know the two wings are separate.

(3) Two extra wings or parts of wings in secondary symmetry. In some of the recorded examples the description is too meagre to allow of classification, in others the extra wing is too rudimentary, or the neuration too abnormal to determine whether it falls into any of these groups.

GROUP I.—MERISTIC REPETITION.

Samia cecropia, L., male. Repetition of anterior part of left forewing. (Strecker, "Entomologica Americana," 1885, i., p. 56. "Proc. Acad. Nat. Sc. Phila.," 1885, p. 26. Bateson, "Materials for the Study of Variation," p. 283.)

Samia cecropia, female. Small right forewing in front of normal forewing, complete but somewhat crumpled posteriorly. (Sampson, ' Psyche," 1904, ii., p., 113, fig., pl. x.)

Naenia typica, L. Two left forewings one behind the other, both well developed, but smaller than usual, and apparently with normal neuration. (Wiskott, "Iris," 1897, p. 391, pl. xii.)

Aglais urticae, L. Hindwing furnished with an additional perfect wing of very small size. ("Proc. Ent. Soc. Lond.," 1845-47, iv., p. 5.) This is probably the specimen figured by Westwood, from the Stephens collection, taken by Doubleday at Epping. ("Trans, Ent. Soc. Lond.," 1879, p. 219, pl. vi.)

Gonepteryx rhamni, L. Two hindwings one above the other; the neuration in each deficient, the anterior part of the neuration normal in one, the posterior part in the other; the neuration of the two together is in excess of that of a single wing. New Barnet. (Westwood, "Trans. Ent. Soc. Lond.," 1879, p. 219, pl. vi.)

Limenitis populi ab. *tremulae*, Esp. There is an extra lobe attached to the posterior margin of the left hindwing; the extra lobe has the neuration of the anterior part of a normal wing. (Wiskott, "Iris," 1897, p. 391, pl. xii. Röber, "Iris," 1884, i., p. 31.)

Pieris brassicae, L. Small additional right forewing lying behind the reduced normal wing. (fig., Guackler, "Illustr. Wchnschr. f. Ent.," 1897, ii., pp. 374-6.)

Brephos parthenias, L. Small additional left hindwing behind the normal one. (Ibid.)

Poecilocampa populi, L., female. Left hindwing slightly crippled. Rudimentary extra wing anterior to right forewing. ("Proc. South Lond. Ent. and N. H. Soc.," 1904, p. 88.)

Zygaena exulans, Hoch., with six wings. Rudimentary fore- and hindwings arise between the left forewing and the corresponding leg. They are both left sided in structure. (Brit. Mus. Coll. Chapman, "Ent.," 1898, xxxi., p. 72. "Ent. Record," 1898, x., p. 107; 1915, xxvii., p. 93.)

Agriades coridon, Poda., female. A small extra hindwing with dark fringe, lying above the middle of the normal hindwing. (Mason Coll. "Nat. Journ.," 1896, v., pl. iv., fig. 10. Tutt, "Brit. Butt.," vol. iv., p. 7.)

Saturnia paronia, L., female. Two small hindwings on left, both with perfect neuration. The second arises on a level with and immediately behind the first. Bateson gives a full description. (Mason Coll. "Proc. Ent. Soc. Lond.," 1888, p. xv.)

Macrothylacia rubi, L., female. Additional hindwing on left side arising immediately above normal wing. It was of normal length but only 6mm. wide. (Speyer, "Stett. Ent. Zeitung," 1888, xlix., p. 206.)

Liparis auriflua, Fab., female. Loughton, 1915. A. W. Mera. Extra forewing lying above posterior part of the left forewing. The wing is 10mm. long, narrow and crumpled. The neuration is obscured. The normal forewing is 20mm. long, but is narrower than the right forewing, and a little curled along the posterior border.

Diloba coeruleocephala, L. There is a small extra left hindwing arising below and in front of the normal hindwing. It is very narrow and very short, with defective and abnormal neuration. The normal hindwing is narrower than the opposite one. Structurally it appears to be a left wing. R. Freer, Rugeley, 1896. N. H. Mus.

The following specimens from the Joicey Collection were shown at the Entomological Society, March, 1921, by Mr. Talbot.

Colias eurytheme, Boisd., male, Texas. An extra right hindwing, the same way up as the normal wing and lying above it. The extra wing is small and curled up, the normal wing is small.

Cosmotriche potatoria, L., female. An extra right hindwing, very small but normal in shape, lies above the normal hindwing, which is pale and reduced in size.

Eudia (Saturnia) paronia, L., female. Germany. An extra left hindwing lies above and in front of the normal one. The normal wing is very small, but is of good colour, and the neuration seems to be unaltered. The extra wing is small but longer than the normal, and pale in colour, due to deficiency of scales. The pattern is a little abnormal, the inner line being bent too sharply inwards behing the ocellus, resembling that of the forewing. The neuration appears to be normal.

Zygaena filipendulae, L., bred, Tatchell, S. Hants, 1913. Extra left hindwing above and behind the normal. Both are reduced in size and the extra wing is very thinly scaled.

All four examples have the extra wing the same way up as the normal one.

Group II.—Mirror images

(a) *Costa to Costa*

Lasiocampa quercûs, L., male. Two right forewings united costa to costa. (Figured by Gauckler, "Illustr. Wochenschr. f. Ent.," 1897, ii., pp. 374-6.)

Crateronyx dumi, L. Two right forewings united costa to costa. (Figured by Wiskott, "Iris," 1897, p. 391, pl. xii.)

Crocallis elinguaria, L. Two left forewings, the costa of the foremost facing that of the normal. (Figured by Wiskott. Ibid.)

Abraxas grossulariata, L. Left forewing with lobe on costa, with mirror image of pattern of neighbouring part of normal forewing. (Figured, "Ent.," 1893, xxvi., p. 145.)

Agriades coridon, Poda, male. Two hindwings united costa to costa; spots all present, but small. (Tutt, "Brit. Butt.," iv., p. 7.)

(b) *Posterior Margin to Posterior Margin.*

Epiblema ustulana, Hübn. Left side normal. Right side normal forewing. No hindwing, but there is a reversed forewing, occupying the position of a hindwing, except that it arises more anteriorly. The colour and pattern, and the structure, are those of a forewing of the opposite side. (Figured, "Societas Entomologica, Zürich," 1909-1910, xxiv., pp. 56, 60.)

(c) *Extra wing above normal wing: upper surfaces face to face.*

Apatura iris, L. Small left hindwing lying face downwards above normal wing. (Figured by Wiskott, "Iris," 1897, p. 391, pl. xii.)

(d) *Extra wing below normal wing: under sides face to face.*

Samia cecropia, L., female. Extra hindwing on left side. "Ent. News. Phila.," 1913, xxiv., p. 337, pl. xi.)

Lasiocampa quercus, L., female. Extra left forewing. ("Berl. Ent. Zeitschr.," 1888, p. 495, pl. vii.)

Group III.

Calcosia venosa, Walk., female. E. E. Green, Ceylon. Three forewings on left side, the first and third half the normal size, the second very small and contorted. The specimen is in the Natural History Museum. It is impossible to determine the true relationship of these wings to one another, but it appears probable that two of them are extra wings in secondary symmetry. ("Ent. Month. Mag.," 1900, xxxvi., p. 197. "Proc. Ent. Soc. Lond.," 1900, p. v. Fuller description, Tutt, "Ent. Record," 1899, xi., p. 203.)

Ematurga atomaria, L. Two extra wings with left hindwing. Rudimentary: perfect fringes. C. P. Pickett, Folkestone. ("Ent.," 1906, xxxix., p. 261. "Proc. Ent. Soc. Lond.," 1906, p. lxvii.)

Male. Central wing half the normal size, the other two rudimentary, one with normal colour and pattern, one plain grey. Captured

April 6th, 1906, Folkestone. (Pickett, "Ent. Rec.," 1906, xviii., p. 190.)

Dasychira pudibunda, L., with three right hindwings. (Honrath, "Berl. Ent. Zeitschr.," 1891, xxxvi., p. iv.)

Arctia caia, L. Three left hindwings, one above the other, close together; well formed. Bred by Hugh Main, 1904. ("Proc. Ent. Soc. Lond.," 1904, p. lv.) This specimen is in the Nat. Hist. Mus.

The costal border of the left hindwing, from base to apex, is single; it divides at the same point into three, each fully scaled on both surfaces, and with perfect fringes.

The upper layer is rather smaller than normal, and its under surface is paler than its upper. The second layer is a good deal smaller, and its upper surface appears paler than its under surface. I think it may be regarded as a mirror image of the upper layer. The third layer is larger than the second, but smaller than the upper or first. Its upper surface is darker than its under surface. It is thus a mirror image of the second. The two lower layers may be regarded as extra parts of a wing in secondary symmetry.

UNCLASSIFIED.

Polyommatus icarus, Rott., male. The left forewing is bilobed, the anterior lobe is in shape and neuration like the anterior part of a normal forewing, but the anterior part of the posterior lobe is quite abnormal in neuration, and does not correspond to any part of a normal fore- or hindwing. The posterior part of the posterior lobe has the neuration of the posterior part of a normal forewing. ("Berl. Ent. Zeitschr.," 1888, p. 495, coloured fig., pl. vii.)

Amorpha populi, L., male. Captured. There is a long appendage at the base of the right hindwing, very rudimentary in structure, but scaled. ("Proc. South Lond. Ent. and N. H. Soc.," 1904, p. 88.)

Janthinea frivaldskyi, Dup. Narrow extra right forewing, anterior part only, lying beneath normal wing. It appears to have underside uppermost, and in that case belongs to Group II. (Wiskott, "Iris," 1897, p. 391, pl. xii.)

Dasychira pudibunda, L. Extra right hindwing. Probably Group II. (Ibid.)

Anthrocera filipendulæ, L. Five wings. ("Ent.," 1910, xliii., p. 44.)

Anchochelis lunosa, Haw., male. Right forewing much broader and differently formed. This is probably a double wing. ("Proc. Ent. Soc. Lond.," 1871, p. xli.)

Gonepteryx rhamni, L. Five wings. J. Woodgate, Brandon, 1873. ("Ent. Mag.," 1878, xiv., p. 189. "Proc. Ent. Soc. Lond.," 1877, p. xxvi.)

Orthosia lævis, Hübn. Additional hindwing on left. Pesth. Mus. (Treitschke, Bd. vi. Abth., ii., p. 407. "Illustr. Wchenschr. f. Ent.," 1897, ii., p. 631.)

Pygaera anastomosis, L. Wing-like appendage to left forewing. Ochsenheimer Coll. ("Illustr. Wochenschr. f. Ent.," 1897, ii., p. 631.)

Nænia typica, L. Additional hindwing. Neustadt Coll., Breslau. (Ibid.)

Zygæna minos, Schiff. Additional forewing left side inserted above and between the normal wings. The shape is that of a hindwing, the colouring that of a forewing. Neuration peculiar. A figure and a diagram of neuration are given. (Rogenhöfer, " Verhandl der Zool-bot. Ges. in Wien.," 1882, xxxii., p. 34.)

Phalæna sp. Five wings. Borckhausen. (" Proc. Ent. Soc. Lond.," 1836, i., p. lxxiv.)

Brephidium exilis, Boisd. Pearson, Pasadena. Right forewing duplicated. (" Ent. Record," 1921, xxxiii., p. 199.)

Arctia caia, L. It is stated that there is a figure of a specimen with five wings in Mosley's " Illustrations of Varieties of British Lepidoptera.." I have been unable to find it. (" Ent. Record," 1909, xxi., p. 75.)

Heliothis incarnata, Frr. Above the right forewing is a narrow, folded, crumpled wing, with fringe plainly visible. (Rangnow, " Berlin Ent. Zeitschr," 1913, lviii., p. (13).)

Ellopia prosapiaria, L. Extra forewing in front of normal forewing on left side. Neuration of both normal, except that a subcostal nervure is absent in the normal. Both are small. The extra wing is twisted, but looks like a wing of the opposite side. (Christeller, " Ent. Mitt.," 1917, vi., p. 123.)

Limnas chrysippus, L., female. Small hindwing lying above the normal hindwing on the left side. Markings absent. (Byatt and Poulton, " Trans. Ent. Soc. Lond.," 1905, p. 263, pl.).

Luperina testacea, Hubn. Five wings. J. A. Clark Coll.

The following are generally included in lists of extra wings, but from their pattern and neuration they appear to be bilobed single wings.

Penthina salicella. Left forewing one quarter wider than right, apical border markedly emarginated. Nervures normal, but cells between subcostal nervures wider than normal. (Rogenhöfer, " Verhandl. der Zool.-bot. Ges. in Wien.," 1882, p. 34.)

Eupithecia castigata, Haw. Deep cleft in left forewing, which is wider than normal. (Wiskott, " Iris," 1897, p. 391, pl. xii.)

Parnassius discobolus, Stgr., male. Deep indentation with what appears to be an extra nervure right forewing. (" Illust. Wochenschr f. Ent.," 1897, ii., p. 374.)

Excluding the cases discussed under Homoeosis, Tannreuther's is the only example of bilateral extra wings. They were discovered in sections through a larva of *Pieris rapae*, L., killed thirty hours before pupation. They lay in the mesothorax and were similar in outline to normal wings, but had no nervures, and only a few minute tracheoles between the two single layers of hypodermal cells. The sections gave no clue to their origin. Figures of the microscopical and general appearance are given. (" Zool. Anz.," 1901, xxiv., p. 620.)

From my list it will be seen that the commonest form of extra wing is that which occurs as a meristic repetition. An extra wing, which is complementary, forming a mirror image of the normal is much rarer. The rarest form is that in which two extra wings are present in secondary symmetry. This condition is almost certainly the result of injury.

Extra wings seem to be equally rare in all families. In species in which two examples are known one may be an example of meristic repetition, and the other may be complementary, as in *Samia cecropia*, *Agriades coridon*, and *Lasiocampa quercus*. In this respect extra wing formation differs greatly from homoeotic repetition of wing pattern.

DUPLICATION OF THORACIC PATTERN.

Manduca atropos, L., male, with two death's heads on thorax. (Swoboda, "Intern. Ent. Zeitschr.," 1909, iii., p. 2.) This doubling of such a distinct thoracic pattern indicates some developmental defect of the underlying chitinous structure of the thorax.

FUSION OF WINGS.

I know only one example of union of a fore- and hindwing. It appears probable that this is due to injury.

Aspilates citraria, Hubn. The two wings on one side united together and not larger than the ordinary size of one of the posterior wings. Westwood, I. of Wight. ("Proc. Ent. Soc. Lond.," 1836, i., p. lxxiv.)

Fusion of any of the appendages in any order is very rare. An example of fusion of two legs in a louse, *Pediculus humanus*, is figured by Keilin and Nuttall. ("Parasitology," 1919, xi., pp. 279-328.)

DEVELOPMENTAL ANOMALIES PROBABLY NOT DUE TO INJURY.

Brenthis euphrosyne, L. Melanic aberration with spatulate part of antennæ nearly double the usual length. ("Proc. Ent. Soc. Lond., 1857, p. 27.)

Parnassius apollo, L., with clubs of antennæ unusually long, and ending in a pointed process. Symmetrical. (Bryk, "Parnassius apollo," Berlin, 1915, Taf. xxxii.)

Melitaea maturna, L. Clubs of antennæ scarcely ½cm. long. ("Ill. Wochenschr. f. Ent.," 1900, v., p. 99.)

Melitaea aurinia, Rott. Antennæ scarcely more than half the usual length. "Ent.," 1872-73, p. 53.)

Ocneria dispar, L. Two correspondents bred large numbers, in which the wings of the males were normal, but many of the females were nearly apterous. ("Ent.," 1888, pp. 235, 322.) This is of interest in view of the apterous condition of the females in many species of the allied genus *Orgyia*, and still more so when one calls to mind *Orgyia thyalina*, Butt., a Japanese species with two forms of female, one fully winged and one subapterous. ("Proc. Ent. Soc. Lond.," 1889, p. viii.) A similar state of affairs exists in *Acentropus niveus*, Oliv., which has females fully winged or with mere rudiments, but no intermediates. Newstead found an almost wingless female of *Himera pennaria*, L., paired with a normal male. From its eggs four imagines were bred, the two females showing to some extent the characteristics of the female parent, the two males being normal. ("Proc. Lanc. and Chesh. Ent. Soc.," 1918, 1919, 1920, xliv., pp. 19, 20.) This species is one in which the female makes little use of its wings.

It is quite likely that in species with winged and almost wingless females, and without intermediates, the almost wingless form arose as a mutation. This view is upheld by Brues, who bases his argument on the condition found in Coleoptera. ("New York Journ. Ent. Soc.," 1908, xvi., pp. 681-693.) And if so, the sudden appearance of a number of almost wingless females in the brood in a genus like *Ocneria* is probably due to a mutation. In *Bombyx mori*, on the contrary, where all grades of defect of the wings occur, Darwin's view that the change has been gradual may be the true one. According to Quatrefages these moths may have their wings reduced to a third, fourth, or tenth part of their normal dimensions, or even to mere short straight stumps in the females. ("Animals and Plants under Domestication," vol. i., p. 320.)

The following are examples of a mutation of considerable rarity, characterised by abnormally short broad wings.

Pterostoma palpina, L., var. *brevipennis*, Chapman. All four wings abnormally short and broad. Several appeared in one brood. (Proc. Ent. Soc. Lond.," 1910, p. lx.)

Naenia typica, L. All four wings very short and very broad. A third of a large brood were in this condition. (Porritt, "Proc. Ent. Soc. Lond.," 1895, p. xlii. Barrett, "Brit. Lepidopt.," pl. 217, fig. l. d.) Porritt states that similar aberrations of *Agrotis tritici*, L., and *Hadena chenopodii*, Fab., are known.

Melitaea aurelia, Nick., *Cidaria fluctuata*, L., and *Zygæna pilosellæ*, Esp., with the same strangely shaped wings are figured by Wiskott. ("Iris.," 1897, Taf. xii., p. 391.)

Macrothylacia rubi, L., male, with short, broad, rounded wings. The transverse lines almost touch one another. Captured by Dr. Nash, Barton, Bedford, 1918.

Zygæna trifolii, Esp., male. An extreme example of this mutation was shown at the Entomological Society of London, October, 1921, and was caught in Sussex by T. H. L. Grosvenor.

Cabera (*Deilinea*) *pusaria*, L., var. *rotundaria*, Haw., probably belongs to this group.

The rarity of the mutation and its occurrence in a proportion of one to three normals, in Mr. Porritt's brood of *N. typica*, L., suggests that it is a Mendelian recessive.

The following examples of symmetrical alteration in the shape of the wings may be mutations, but there is no evidence to prove this.

Agriades coridon, Poda., male, with broad round wings. Alton Barnes. Rev. C. A. Sladen's Collection.

Callimorpha dominula, L., with rounded wings. ("Proc. South Lond. N. H. Soc.," 1911, p. 81.)

Pyrameis atalanta, L., with very broad wings. (Ibid, 1899, p. 108.)

Zygæna lonicerœ, Esp., with forewings abnormally broad or narrow. (Hewitt, "York. Ent. Record," 1890-91, i., pp. 59, 60.)

Hemaris fuciformis, L. A very small specimen with very broad border, almost reaching the disc, and with very narrow wings, was bred by Mr. Burnett from a Horsley larva, and shown at the South London N. H. Society, November 25th, 1920.

Colias edusa, L., with narrow forewings. (Cockerell, "Ent.," 1889, xxii., p. 147.)

Melanippe fluctuata, L., with long narrow wings like a *Eupithecia*. ("Ent. Record," 1905, xvii., pp. 311-315.)

Laertias philenor, L. A number bred together with the tails considerably aborted. ("Ent. News. Phila.," 1908, xix., p. 85.)

The specimen of *Wheeleria spilodactyla*, Curt., with no cleft instead of one cleft in the forewings, and one cleft instead of two in the hindwings, is almost certainly a mutant. ("Ent. Record," 1912, xxiv., p. 50.)

A series of remarkable aberrations of *Thais rumina*, L., most of which come from Algeria, is known. They affect the semicircular indentations of the wing membrane between the nervures. The indentation between one or more nervures appears as if cut straight, and the usual concave black marking is correspondingly straightened. The abnormality is bilaterally symmetrical. A series of these is figured by Oberthür under the title "Deformation de la dentelure des ailes." ("Études," 1915, x., pl. cclxxvii., figs. 2259-2263.) The form with the hindwing cut square, as if by scissors, is described and named ab. *distorta*, Rothsch. ("Nov. Zool.," 1918, xxv., p. 75.) A specimen of *Thais polyxena*, Schiff., with extreme alteration of shape and pattern is figured ("Berl. Ent. Zeitschr.," 1910, lv., Taf. i., fig. 1.) A similar one is figured (Herrich-Schäffer, "Europaische Schmett," 1843, vol. i., Taf. 116, figs. 557 and 558.)

Ocneria dispar, L. Enock bred 800 males and females in 1867, in nearly all of which the hindwings had a deep crescentic notch extending inwards as far as the discal area. A coloured plate is given ("Ent.," 1878, p. 169). The same form was bred again, and is mentioned as a constantly recurring aberration (ibid, 1884, p. 17). Numbers were bred again years later (1889, p. 259). Some bred by Mr. Bankes, from larvæ of American origin, are in the Brit. Mus. Teratological Coll. In these the females are much less affected. The uniformity of the defect and its constant recurrence point strongly to its being a mutation.

Developmental Abnormalities in the Ovaries.

Doncaster reports the discovery of a female *Abraxas grossulariata*, L., with six egg-tubes instead of four, but does not say whether the condition was bilateral. ("Journ. of Genetics," 1913-1914, iii., p. 6.)

I recorded a female *Agriades coridon*, Poda., with three egg-tubes on each side instead of four. It was a gynandromorphous specimen, ab. *roystonensis*, Pickett. ("Trans. Ent. Soc. Lond.," 1916, p. 252.) This year, 1921, I found the same condition in one specimen of the parallel gynandromorphous form of *Plebeius argus*, L.

ABSENCE OF ANTENNÆ.

Strymon pruni, L., female, bred without antennæ. ("Proc. South Lond. N. H. Soc.," 1891, p. 106.)

Manduca atropos, L. Right antenna absent. The antenna case of the pupa was very short and stuck out like a horn. ("Ent. Mag.," 1865-6, ii., p. 167.)

Zygæna loniceræ, Esp. Bred with one antenna absent. ("Societas Ent.," 1890-91, p. 75.)

Phragmatobia fuliginosa, L. Bred with an antenna absent. ("Ent. Mag.," 1880-81, xvii., p. 48.)

Cymatophora diluta, Fab., and *Scopelosoma satellitia*, L. Each with only one antenna. ("Proc. Ent. Soc. Lond.," 1871, p. vii.)

Sphinx ligustri, L. Right antenna absent, left represented by a knob, proboscis malformed, wings crippled. (Bristol, 1901. Brit. Mus.)

Parnassius apollo, L. Antenna missing. (Bryk., "Soc. Ent. Zurich," xxix., p. 20, fig.)

Zygæna loniceræ, Esp. Bred with only one antenna. (Klemensiewicz, "Soc. Ent. Zurich," 1890-91, p. 75.)

Larvæ of *Pieris brassicæ*, L., were fed between poles of a magnet. only one survived, and had rudimentary stumps in place of antennæ, the legs on the left smaller than on the right, and the wings on one side unexpanded. Controls were normal. (Slater, "Proc. Ent. Soc. Lond.," 1885, p. xv.)

ABSENT ANTENNA AND EYE.

Spilosoma menthastri, Schiff. The right antenna and eye are missing. There is a hollow where the eye should be, but it is concealed by scales, and it is impossible to see whether a rudimentary eye is present. (Montgomery. Bred Ealing, May 6th, 1900. Brit. Mus.)

ABSENT HEAD.

Phragmatobia fuliginosa, L. Head and neck missing. No scar on thorax, which had hair in front where the head ought to have been. (Nécsey, "Illustr. Wochenschr. f. Ent.," 1900, v , p. 170.)

ABSENCE OF WINGS.

This is quite common. Sometimes there is no trace of the missing wing, sometimes it is represented by a minute knob.

Zygæna filipendulæ, completely apterous. Bred Folkestone. ("Proc. South Lond. N. H. Soc.," 1887, p. 79.)

Hybernia defoliaria. No wings on right side. ("Ent.," 1905, xxxviii., p. 22.)

Acronicta megacephala. Two wings only. ("Proc. Ent. Soc. Lond.," 1880, p. xxx.)

Hylophila bicolorana. No left forewing, rudimentary left hindwing. (H. Worsley Wood. Bred Wimbledon, 1919.)

Hemerophila abruptaria. Bred with no left forewing. ("Ent.," 1904, xxxvii., p. 328.)

Abraxas grossulariata (two with left forewing absent), *Anticlea cucullata* (left forewing absent), *Melitæa athalia* (right forewing absent).

The following specimens with a hindwing absent have been recorded. *Melitæa varia* ("Proc. Ent. Soc. Lond.," 1911, p. vi.), *M. artemis* ("Ent.," 1883, p. 257), *Limenitis sibylla* (ibid), *Erebia eriphyle* ("Proc. Ent. Soc. Lond.," 1911, p. vi.), *Erebia æthiops* (two) (Tutt, "Ent. Rec.," 1908, xx., p. 221), *Abraxas grossulariata* (two) (Porritt, "Proc. Ent. Soc. Lond.," 1913, p. lxix.), *Notodonta ziczac*, *Pygæra bucephala*, *Dicranura vinula* ("Ent.," 1870, pp. 147, 173), *Pandemis ribeana* ("Soc. Ent.," 1890-91, p. 75), *Macaria notata* (Bird, "Ent. Rec.," 1905, xvii., pp. 311-315), *Ithysia hybr. harrisoni* ("Trans. Lond. N. H. Soc.," 1916, p. 19), *Melanippe subtristata* ("Proc. South Lond. N. H. Soc.," 1891, p. 106, and "Nat. Journ.," 1895, iv., p. 163), *Harpalyce galiata* ("Proc. Ent. Soc. Lond.," 1856, 4, p. 22), *Dianthoecia carpophaga* ("Bull. Ent. Soc. de France," 1853, p. xxxix.).

In the Brit. Mus. are the following :—*Mamestra persicariæ*, *Cucullia asteris*, *Phibalapteryx vitalbata*, *Emmelesia alchemillata* and *E. unifasciata*, *Larentia hastata*, *Cidaria testata*, *Hybernia leucophæaria*, *H. defoliaria*, *Camptogramma bilineata*, *Drepana falcataria*, *Lymantria monacha*, *Colias edusa*, *Melitæa artemis*, *Papilio machaon*, *Cœnonympha pamphilus*, *Cacæcia piceana*, and in my collection *Agrotiphila quieta* (Yukanski, 1917), *Nænia typica*, Clapton.

Although one would expect a forewing to be absent more often than a hindwing, owing to its greater exposure to injury, a missing hindwing is about six times as common as a missing forewing.

The following two records suggest that injury cannot be the sole cause of absence of wings.

Barrett states that at West Wickham Wood, before the insect finally disappeared from this locality, three-winged *Macaria notata*, L., were not uncommon in both broods, one or other hindwing being entirely absent. One specimen with no hindwings was caught. ("Brit. Lepidopt.," vol. vi., p. 375.)

C. H. Sladen writes that he bred some *Cidaria testata* most of which lacked one hindwing, and one had both missing. They were fed on sallow, had plenty of food, and the pupæ were left undisturbed. ("Ent.," 1887, xx., p. 306.)

Of interest also from this point of view is the record of a *Theretra* (*Deilephila*) *elpenor*, L., with three wings, bred from a perfectly normal pupa. ("Zeitschr. f. Wissensch. Insektenb," 1911, vii., p. 398.)

Many leaden and some asymmetrical *Abraxas sylvata* were taken one year near York. Most were crippled and some lacked hindwings. ("Proc. Ent. Soc. Lond.," 1897, p. xlix.)

In these the absence of wings was probably developmental, and associated with the abnormal pigmentation, and not due to any mechanical injury.

SMALL ANTENNÆ.

Pieris brassicæ, L. One antenna very small but perfect. ("Proc. South Lond. N. H. Soc.," 1891, p. 121.)

Pyrameis atalanta, L. Left antenna half the usual length. ("Proc. Ent. Soc. Lond.," 1865, p. 115.)

Arctia caia, L. Right antenna small, right hindwing yellow, rounder than the left and abnormally marked. (Clement, "Bull. de la Soc. Ent. de France," 1914, p. 495.)

Pieris rapæ, L., female. Right antenna a quarter the length of left. (Graves, "Ent. Record," 1921, xxxiii., p. 45.)

Apatura ilia, Hübn. Right antenna smaller than left. (Christeller, "Ent. Mitt.," 1917, vi., p. 31, fig.)

Manduca atropos, L. Right antenna 1mm. long, left 2mm. long. (Ibid, fig.)

Limenitis sibylla, L. Right antenna about one-third the normal length. H. Worsley Wood.

Small Legs.

Arctia caia, L. Right metathoracic leg extremely small. Brescia, 1907. ("Chinaglia. Redia.," 1915, x., p. 10, fig.)

Both wings small on one side.

Papilio krishna (Manders, "Proc. Ent. Soc. Lond.," 1907, p. lxiv.), *Zygæna hippocrepidis* (Tutt, "Brit. Lepidopt.," i., p. 533), *Hipocrita jacobææ* (Bird, "Ent. Record," 1905, xvii., pp. 311-315), *Arctia caia* (two) ("Proc. South Lond. N. H. Soc.," 1909, p. 91) and one ("Proc. Ent. Soc. Lond.," 1845-7, 4, p. 85), *Tephrosia consonaria* (Robertson, "Ent. Record," 1902, xiv., p. 80), *Vanessa io* ("Trans. City of Lond. N. H. S.," 1911, p. 5), *Pyrameis atalanta* ("Proc. Ent. Soc. Lond.," 1865, p. 115).

In the British Museum, *Agrotis sancia*, *Plusia gamma*, *Abraxas grossulariata*, *Agriades thetis*, *Pyrameis atalanta*, *Noctua neglecta* (in my own collection), *Everes dipora*, *Aglais urticæ*, *Cymatophora duplaris* (Brit. Mus.), *Telea polyphemus* (Enderlein, "Zool. Jahrb. Abt. f. Anat. u. Ontog. d. Tiere." 1902, xvi., p. 37), *Agrotis placida* and *A. introferens* ("Proc. Ent. Soc. Wash.," ii., p. 181).

Both Forewings small.

Diacrisia rubida (mere scales) ("Ent. Mag.," 1900, xxxvi., p. 197), *Heteromiza obliquaria* (mere scales) (Brit. Mus.), *Zygæna filipendulæ*, both forewings and left hindwing minute, right absent (Brit. Mus.), *Triphœna comes* ("Proc. Ent. Soc. Lond.," 1855, 3 n.s., p. 80).

One Forewing small.

Pyrameis atalanta (three) (Tutt, "Trans. City of Lond. N. H. S.," 1891, p. 15. "Proc. South Lond. Ent. Soc., 1899, p. 108), *Colias edusa* (Agassiz, "Mitth. Schweiz. Ent. Ges.," 1897-1903, x., p. 22), *Argynnis aglaia* ("Ent. Record," 1908, xx., p. 148), *Agriades coridon*, male (E.A.C.), *Hyponomeuta cognatella* ("Ent. Mag.," xxv., p. 306), *Apocheima hispidaria* ("Proc. Ent. Soc. Lond.," 1900, p. v.), *Hybernia leucophæaria* (three males) (E.A.C.), *Abraxas grossulariata* (four), *Boarmia repandata*, *Acidalia inornata* (small wing pale), *Zonosoma punctu-*

laria, *Anticlea badiata*, *Triphæna subsequa*, *Zygæna filipendulæ*, *Caradrina quadripunctata*, *Heliophobus hispidus*, *Noctua triangulum* (C. Nicholson), *Hoporina croceago*. In some cases the small forewing is very perfect in shape and neuration.

BOTH HINDWINGS SMALL.

Macaria notata ("Proc. Ent. Soc. Lond.," 1856, 4, p. 22), *Deilinea pusaria*, *Agrotis comes*, *Anarta myrtilli*, *Eupithecia coronata*, *Biston betularia*, *Manduca atropos*, *Arctia caia* (Brit. Mus.), *Acronicta megacephala* (C. Nicholson), *Lycia hirtaria* ("Ent. Record," 1898, x., p. 154).

ONE HINDWING SMALL.

Melitæa deione (a rather common defect in this family. Pearson, "Ent. Record," 1908, xx., p. 54), *Dryas paphia* ("Ent.," 1919, p. 23), *Erebia* var. *adyte* ("Proc. Ent. Soc. Lond.," 1911, p. vi.), *Parnassius apollo* (Mühling, "Ent. Zeitschr.," 1913-14, xxvii., p. 305), *Thecla ilicis* ("Soc. Ent.," 1890-91, p. 75), *Aricia medon* ("Ent.," 1919, p. 234), *Amorpha populi* ("Nat. Journ.," 1895, iv., p. 163), *Macaria notata* ("Jenner Weir. "Proc. Ent. Soc. Lond.," 1856, iv., p. 22), *Hybernia leucophæaria* ("Ent. Record," 1902, xiv., p. 129), *Amorpha populi* and *Zygæna filipendulæ* (Fletcher, "Nat. Journ.," 1895, iv., p. 163), *Epinephele amaryllis*, *Aglais urticæ*, *Pyrameis atalanta*, *Melitæa athalia*, *Pamphila palæmon*, *Aricia medon*. *Planema aganice*, *P. umbra*, *Agriades thetis*, *Leucania conigera*, *Dryobota protea*, *Xanthia flavago*, *Miana furuncula*, *Hygrochroa syringaria*, *Boarmia roboraria*, *B. cinctaria*, *Abraxas grossulariata*, *Eucosmia certata*, *Coremia propugnata*, *Selidosema plumaria*, *Opisthograpta clathrata* (2), *Eupithecia pulchellata*, *Hybernia defoliaria*, *Hemaris tityus*, *Sphinx ligustri*, *Clisiocampa castrensis*, *Gastropacha quercifolia*, *Bombyx quercûs*, *Cidaria siterata*, *Phibalapteryx tersata*.

These lists are taken at random and bring out the fact that small hindwings are much commoner than small forewings, just as the absence of hindwings is commoner than that of forewings. They also show that all families are affected in this way, though perhaps *Geometridæ* are most prone to this kind of defect.

Occasionally all the wings may be small.

Lycia hirtaria, with wings represented by mere rudiments. (Robbe, "Ann. Soc. Ent. Belge.," 1892, xxxvi., p. 514.)

Eupithecia scabiosata, both forewings and right hindwing rudimentary, left hindwing very small. (British Museum.)

ABSENT CLASPERS.

Papilio machaon, L. Larva with only one clasper on the 7th segment. It was lost at the second ecdysis.

Aglais urticæ, L. Larva with no claspers on 8th segment, where there was a black scar.

Both were probably due to injury, though none was noticed. (Chrétien, "Le Naturaliste," 1887, p. 185).

ABSENT SPIRACLE.

Telea polyphemus, Cram. Full-grown larva with spiracle of 8th abdominal segment missing and replaced by a wart-like protuberance. The stripe on this segment was absent. The larva was parasitised, which may account for the condition. ("Ent. News. Phila.," 1913, xxiv., p. 195.)

ABSENT ABDOMEN.

Eugonia polychloros, L. Of three pupæ one was opened to show to a friend. The wings, legs, and antennæ were normal, but there was no trace of the abdomen. The insect was alive, and next morning crawled about with three fully developed wings, and had a large transparent body on it. This was no doubt extruded from the thorax. (Tillyard, "Nat. Journ.," 1895, iv., p. 180.)

Melitæa cinxia, L. Amongst a number of pupæ from collected larvæ the abdomen of one shrivelled. It was put apart and an imago emerged with crippled wings and without abdomen. The posterior end of the thorax had a rough appearance. There was no trace of abdomen in the pupa case. (H. Worsley Wood, I. of Wight, 1920.)

Manduca atropos, L. A specimen with normal wings, thorax without the death's head, abdomen very short, as if cut down to less than half its length. In the figure only the first two segments are visible. The rest are missing or very small and retracted. (Ernst, "Papillons de l'Europe," 1779, vol. iii., pl. cxxii., fig. 154n.)

MALFORMATIONS PROBABLY DUE TO INJURY.—ABNORMAL ANTENNÆ.

Pupa of *Sphinx* (*Hyloicus*) *pinastri*, L-, with antenna sheaths malformed, forming a ring. (fig., "Illustr. Wochenschr, f. Ent.," 1896, i., p. 563.) Pupa of *Iphiclides podalirius*, L. Antenna sheaths stuck out like handles. (Ibid, 1897, ii., p. 479.)

Lymantria, hybrid. Abnormal hypertrophied antenna. (Lindner, "Zeitschr f. Wissensch. Insektenb," 1913, ix., p. 377, fig.)

Arctia caia, L. Female bred with antennæ very short, resembling clubs of butterfly's antennæ. Pupa case showed abnormal position of antenna sheaths. Full description given. ("Proc. Ent. Soc. Lond.," 1886, xix., p. xlix.)

Melitæa cinxia, L. Apical half of antenna aborted. ("Proc. Ent. Soc. Lond.," 1871, p. vii.)

Zygæna filipendulæ, L., with both antennæ twisted back on themselves, forming a ring in the centre. Brit. Mus.

Samia cynthia, Drury, male. Right antenna much hypertrophied, with structure quite irregular.

Psilura monacha, L. Left antenna with a flat plate of chitin bent out in the middle. (Lindner, "Zeitschr. f. Wiss. Insektbiol.)

It is quite usual to meet with shortening of one antenna, due to failure of the end to develop properly, and this is often associated with some malformation of the of the forewing of the same side. Some examples are given by Christeller. (Ent. Mitt.," 1917, vi., p. 31.)

HOLES IN THE WING.

Cosmia trapezina, L. Five large holes in right forewing and two in right hindwing. ("Berl. Ent. Zeitschr.," xxxii., pp. 203 and 227, fig.)

Pyrameis atalanta, L. Round hole between veins 3 and 4 left forewing. ("Proc. South Lond. N. H. Soc.," 1899, p. 108.)

Euchloë cardamines, L. Round hole between veins 3 and 4 left forewing, and large hole left hindwing, with discocellular nervure displaced outwards round it. ("Trans. Lond. N. H. Soc.," 1915, p. 74.)

Polyommatus icarus. Large hole in left forewing.

Terias, sp. Hole in right forewing. (Ibid.)

Xanthia fulvago, L. Hole in left hindwing near margin, and slit in termen of left forewing, opening into large round hole. The positions of holes in the two wings correspond. Two very deep notches in right hindwing and one in right forewing, all near apex. (Brit. Mus.)

Chapman considers that such holes are due to injury to the pupa just after having cast the larval skin. He had a larva on which a piece of sawdust fell just after it pupated. The wings afterwards covered it in, and there was a hole in the same position in the wing of the imago. ("Ent. Record," 1890-91, i., p. 272.)

McArthur bred an *Arctia caia*, L., with perforated wings, caused by the larva pupating on the sandy floor of the cage. A piece of grit pierced the wing case. There was also an indentation of the hindwing perfectly ciliated, which was probably caused by another piece. ("Nat. Journ.," 1897, vi., p. 148.)

A number of species with holes in the wings are figured by Christeller. ("Ent. Mitt.," 1917.)

Rounded indentations are sometimes produced in the posterior margins of the forewings or of both pairs of wings in Lepidoptera, which attach the pupa by a silken belt. In the British Museum are two *Gonepteryx rhamni*, females, with the mark of the silken belt across the forewings and a rounded indentation in the posterior margin of each, and an *Aporia crataegi* with the posterior margin of the left forewing slightly indented, and that of the right deeply indented. *Pieris brassicæ* indented by silk girdle in all four wings. (Main, "Ent. Record," 1904, xvi., p. 293.)

Iphiclides podalirius, with termen of each forewing indented is figured by Christeller ("Ent. Mitt.," 1917, vi., p. 110).

Many other malformations, doubtless due to injuries, have been recorded.

Symmetrical notches in both forewings, both wings on one side, or in all four wings, ciliated or not ciliated, are well known.

Ocneria dispar. Symmetrical ciliated notches in both forewings. Two bred. (Taylor, "Nat. Journ.," 1898, vii., p. 136.)

Oporabia autumnata. Notch in each forewing. ("Proc. South Lond. N. H. Soc.," 1900, p. 106.)

Zygæna achilleæ. Similar specimen. ("Ent. Record," 1915, xxvii.,

p. 93.) *Syrichthus malvæ.* Ciliated notch at apex in all four wings. ("Proc. South Lond. N. H. Soc.," 1896, p. 47.)

Indentations of the termen, generally broad and shallow, are common in both wings on one side, both forewings or all four wings, or in one wing only.

Oberthür figures three specimens of *Parnassius apollo*, two with this deformity of the right forewing, and one with it in both wings on the right side. ("Études. Lep. Comp.," 1891, xiv., pl. ii.)

Deilephila euphorbiæ. Termen symmetrically indented in forewings. ("Ill. Wochenschr. f. Ent.," 1898, iii., p. 232.)

Lycæna semiargus. Deep notch symmetrically placed in all four wings. (Fromholz, "Berl. Ent. Zeitschr.," 1880, xxxii., p. 225, pl. ii.) In the British Museum are specimens of *Pachnobia hyperborea*, *Hipocrita jacobææ*, *Papilio machaon*, with both forewings, and *Parasemia plantaginis* with all four wings affected, and two *Agriades thetis* with the two wings on one side only indented. Indentations of the costa, symmetrical or unilateral, are fairly common. Sometimes the proximal part of the costa forms a sharp hooked projection. A figure of *Lasiocampa fasciatella* with this condition of the left forewing is given. ("Ill. Wochenschr. f. Ent.," 1898, iii., p. 38.) In the British Museum is a male *Hybernia defoliaria* with the condition more marked on the right side.

Tephrosia crepuscularia, both costæ symmetrically affected. ("Proc. South Lond. N. H. Soc.," 1906, p. 41, fig.)

Zygæna achilleæ and *Pararge mæra* with symmetrical depression of costa; nervures normal. (Chapman, "Proc. Ent. Soc. Lond.," 1914, p. lxxxiv.)

Psilura monacha. Both wings on the left side narrow, anterior margins depressed and apices very sharp. ("Berl. Ent. Zeitschr.," 1909, p. 54, Taf. i.) There is a somewhat similar specimen of *Œneis norna*, Thnb., in the British Museum.

Amongst several examples of Lepidoptera with abnormal wings a most remarkable *Saturnia pyri* is described and figured. The wings on the right side were deeply hollowed out, and the hindwing margin was at one point prolonged into a sharp process extending far beyond the limit of a normal wing. (Aigner-Abafi, "Illustr. Wochenschr. f. Ent.," 1900, v., p. 99.)

Symmetrical malformations in the following species are described and figured, *Vanessa io* with the posterior half of each forewing missing, *Saturnia pyri* with deep incurving of the costa of each forewing, *Antheræa pernyi* with a deep excavation at the apex of all four wings, *Gastropacha quercifolia* with a crescentic piece missing at the anal angle of each hindwing, and *Notodonta dictæoides* with the termen concave in each forewing. Some asymmetrical malformations are also figured. (Gauckler, "Illustr. Wochenschr. f. Ent.," 1897, ii., pp. 84-87, and pp. 374, 417, 418. O. Schultz describes others (ibid p. 143).) A symmetrically malformed and pale *V. io*, bred during temperature experiments, is figured (ibid p. 417).

A truncated condition of the apex of the forewing is not uncommon.

There are several examples in the British Museum. Shortening and broadening of the whole of a forewing with concavity of the termen may occur. Two specimens of *Aglais urticæ* in the same collection show this deformity. Both are probably due to pressure of the apex on termen against some hard object just after pupation.

The British Museum has a specimen of *Nonagria geminipuncta* with left hindwing produced into a narrow ribbonlike strip, much longer than the normal hindwing, and a *Zygæna filipendulæ* with both forewings appearing as if cut off with a pair of scissors, leaving a sharp V-shaped incision, extending to the spots nearest the base, and with the hindwings small.

A *Telea polyphemus* is figured in which all the wings are abnormally shaped, and those on the right are different from those on the left, but all are perfect. ("Psyche," 1904, ii., p. 113, pl. x.)

The pattern in abnormal wings is often abnormal also.

Caradrina ambigua. Left forewing broad and indented, reniform and orbicular joined into large patch. ("Proc., Ent. Soc. Lond.," 1894, p. xl.)

Cheimatobia brumata, with only three wings, differing in colour and markings. ("Ent.," 1872-73, p. 53.)

Opisthograpta clathrata. No left hindwing, abnormal darkening left of forewing. (E.A.C.)

Rumicia phlæas. No left forewing, left hindwing suffused. (Tutt, "Brit. Butt.," vol. i., p. 380.)

Arctia hebe. Left side normal, right a uniform brownish colour and subdiaphanous. ("Berl. Ent. Zeitschr.," 1910, lv., p. 495, pl. vii.)

Zygæna filipendulæ ab. *flava.* Left forewing small and with large yellow area near base spreading out from the spots. (E.A.C.)

Plusia gamma. Right forewing dwarfed and with large bleached patch. ("Trans. City of Lond. Ent. Soc.," 1911, p. 12.)

Argynnis aglaia. Left wings both smaller than right and with white patches in them. ("Proc. South Lond. Ent. Soc.," 1904, p. 82.)

Tenaris, sp. Forewing on left side with distorted nervures. In left hindwing nervure 3 is bent aside to touch 4 near the ocellus, but reaches the margin in the usual place. The ocellus lies as usual between 2 and 3, but the ring round it instead of just crossing 2 and 3, does not quite reach 2, and is produced forwards considerably beyond 5.

Instances of this kind could be multiplied indefinitely, but they are especially common in the Lycænidæ in association with striated and obsolete forms. Tutt, in "British Butterflies," vol. i., p. 7, has commented on this in the case of *Agriades coridon*, and Pickett ("Trans. City of Lond. Ent. Soc.," 1905, p. 52) mentions how often obsolete forms have some deformity of the wing, small holes in the membrane, or one wing missing or rudimentary.

The association of bleaching with various malformations appears to be of some importance.

Direct evidence of the cause of any given malformation is seldom obtained. I have quoted two definite cases of holes in wings of which the cause was known. Chapman records a *Libythea celtis* with a shortened wing, the result of a displaced antenna in the pupa ("Proc. Ent. Soc. Lond.," 1910, p. lx.), and Bird noticed a scar on the 2nd or 3rd segment of a larva of *Pararge ægeria*, which afterwards produced an imago with the 3rd and 4th nervures of the right forewing curving away from one another, and with the termen between them forming a triangular projection. ("Ent. Record," 1905, xvii., pp. 311-315.)

Manduca atropos, L. Two small parasites emerged from holes in the wing cases of two pupæ, and the imagines had holes the size of a quill in the upper wing on each side near the edge. Tutt quotes this doubtful record. ("Brit. Lepidopt.," vol. iv., p. 434.)

Epinephele tithonus, L. I have bred specimens, one with a hole in one forewing and a semi-circular gap in the posterior margin of the other, and two with semi-circular gaps in the termen of a forewing. The defects were caused by local pressure on the pupa applied a day or two after pupation. The pupa must be hard enough for pressure to cause a distinct indentation of the wing case. Great distortion of a very soft pupa does not prevent perfect wing development.

Harrison remarks on the frequency of teratological hybrids lacking portions of wings, or showing portions developed to an exaggerated extent. He thinks this may be due to irregular chromosome division at a late stage of development. ("Journ. of Genetics.," 1916-1917, vi., pp. 115 and 126, pl. iii., fig. 3, No. 1, and fig. 4, Nos. 2 and 4.)

There may be other records but I am unaware of them.

The symmetrical indentation of the costa of each forewing is probably due to incomplete casting of the larval skin. The larval head becomes fixed at some point along the anterior aspect of the pupa and causes a concave indentation, which includes the front of both wing cases. The deformity is figured and described in *Epinephele jurtina*, L., as ab. *costa-cava*, Cabeau. ("Rev. Ent. Soc. Namuroise," 1904, p. 58.)

WAVY NERVURES.

Nectaria tondana, Voll. Every nervure in all four wings wavy instead of straight, including the costal. The wing membrane quite smooth and tightly stretched, and with normal scales. Specimen full size. (Brit. Mus.)

Melanitis leda, Fabr. Nervures in the same condition, but the membrane is a little wrinkled and the scales rather deficient in pigment. Specimen full size. (Brit. Mus.)

Aporia crataegi, L. An illustration of a specimen with undulate nervures and deep notches in all four wings, caused by a tight pupal girdle, is given by Krancher ("Psyche," iv., p. 202). The specimen is narrow winged and small in size.

Papilio restrictus ab. *undulosus*, Oberth. Female, Tibet. Well expanded and symmetrical, but with all the nervures wavy. Pigmentation normal. Oberthur states that he has never seen this form of variation before. ("Études. Lep. Comp.," 1911, v., pt. i., pl. lxviii., fig. 651.)

GENITAL MALFORMATION.

A peculiar malformation of the male genitalia has been recorded once in *Acronicta tridens*, Fab. ("Proc. South Lond. Ent. Soc.," 1910-11, p. 50), once in *Hydraecia paludis*, Tutt; Burrows, ("Ent. Record," 1912, xxiv., p. 169), and twice in *Fumea casta*, Burrows (ibid, 1918, xxx., p. 82). In these insects the penis, penis sheath and valves remained as internal organs. Chapman states that he has produced the condition artificially in *Ocneria dispar*, L., by a slight injury to the larva between the 9th and 10th abdominal segments in the midventral region. The penis and sheath develop from the internal part of a small mass of tissue called Herold's corpuscle, the valves from a small invagination of the posterior margin of the 9th abdominal segment, which unites with the internal part of the corpuscle.

Meisenheimer excised the whole corpuscle in *Ocneria dispar*, L., larvæ, and his imagines had no penis, sheath, or valves. ("Trans. Ent. Soc. Lond.," 1912, p. 407.)

Valves in the intra-abdominal position are not uncommon in the intersexes, which replace females, in *Amorpha* hybrid *hybridus*, Steph., but in this case it is due to an arrest of development without any injury.

DEFECTS OF SCALE DEVELOPMENT.

1. Complete absence, local or general. Diminution in number, sometimes associated with very narrow scales, local or general.
2. Narrowness of scales, local or general.
3. Absence of hairs on the wings, thorax and abdomen.
4. Scales with absence or deficiency of pigment and unduly thin, so that they curl up at the edges, or are rolled up so as to form a pointed extremity. This usually gives the wing a white appearance, and is the condition found in most albinistic forms.
5. Scales normal in number or diminished, with little or no diminution in the amount of pigment but some alteration in its colour, turned upwards and bent over, or twisted into a spiral. The scale is often twisted so tightly that the distal half or two thirds resembles a coarse hair.

In some cases only the upper layer of scales is affected; in others both layers and the wing membrane in this case is exposed.

6. Scales with the proximal part flat, but with the extremity turned sharply upwards so as to point vertically and lie at right angles to the wing membrane.

SYMMETRICAL DEFICIENCY OR ABSENCE OF SCALES.

In Lord Rothschild's collection there are single specimens of *Abraxas grossulariata* and *A. sylvata* entirely without scales.

In Mr. Bright's collection the following specimens with deficient scales exist. *Thecla quercûs*, scales few on the underside of all four wings. *T. w-album*, hindwings semitransparent owing to irregular absence of scales; scale sockets present. Two *Satyrus semele* with pale cream coloured wings. Upper scales without pigment and reduced in number, under scales transparent. Sex brands normal.

Euchloë cardamines, L., male. Both hindwings nearly transparent in central and basal areas. Scales very few and narrow and in places only represented by short, thin, white hairs. Colchester bred.

Argynnis aglaia, L. Outer part of all four wings transparent, fringes perfect. A few scales are present, but the sockets for the normal number are visible. ("Ent.," 1921, liv., p. 79.)

Melitæa artemis. Scaleless except base of wings and fringe in all four wings. Sockets present. Galway, bred.

Endromis versicolor, L. Basal and central areas scaleless.

Odontoptera bidentata. Base and central area partly scaleless. (Two in Rothschild Coll.) I bred two similar specimens from inbred stock.

Pararge ægeria, female. Scales deficient in number all over the wings except the marginal area. Fringes perfect. Scale sockets deficient in number. Scales normal. One of a number bred from eggs (Limber, October 12th, 1916). Larvæ and pupæ kept in closed tin. Other normal specimens bred with this.

Agriades coridon, female. Outer half of each forewing transparent. Nearly all the scales are absent, especially towards termen, but the fringes are perfect. The few scales present on the transparent part, and many at the junction between the transparent and normal part of the wing, are unpigmented, thin, and curled up. (Royston, Bright Coll.)

Cyaniris argiolus, female. Almost symmetrical absence of scales between the nervures in the black apical part of each forewing. Fringes normal, black scales present along nervures, costa, and at line of junction with the blue part of the wings.—H. B. Williams.

Hipocrita jacobææ. Subdiaphanous specimen with outer three-quarters of hindwings grey. The scales are narrow and deficient in number. On the grey part of the hindwing the scales are thinly pigmented and grey in colour. (F. Mann, Mickleham Down, 6.6.15.) A similar specimen is recorded from Oxshott. (Buckstone, "Ent. Record," 1915, xxvii., p. 143.)

Diaphora mendica var. *rustica*, two females. Scales too narrow and few in number. A male has no black scales, and on the hindwings the scanty scales are almost as narrow as hairs. (Inbred specimens. Many larvæ died of disease.)

Saturnia pavonia. Deficiency of scales is rather common in this species. There is one in the British Mus. Teratological Coll., another is mentioned by Bateson. A specimen from a starved larva is mentioned by Tiltscher. ("Ent. Zeitschr.," 1912-13, xxvi., p. 54.)

Aporia cratægi, L., scaleless. (Slevogt, "Ent. Wochenbl.," 1907, xxiv., p. 130.)

Lasiocampa quercus var. *callunæ*. A male and female almost destitute of scales, especially over outer part of wings. The larvæ were fed on ivy, and other imagines were normal (Varley Coll. Mosley's Illustrations). A similar specimen, a female, is in the British Museum

General Collection. Another is recorded ("Proc. South Lond. N.H. Soc.," 1895, p. 47).

Euvanessa antiopa, L. No scales on the wings except on the marginal area. The pupa was exposed to a high temperature. (fig., "Illustr. Wochenschr. f. Ent.," 1897, ii., p. 162.)

Thais rumina, L. Subdiaphanous specimen with scales well formed and pigmented, but widely spaced, showing wing membrane between (Brit. Mus.).

Lophopteryx carmelita, almost scaleless. *Catocala lupina* and *Pygæra pigra*, thinly scaled. ("Berl. Ent. Zeitschr.," 1896, xli., p. (3).) *Saturnia pavonia*, *Platysamia cecropia*, *Saturnia pyri*, thinly scaled. Cold weather delayed scale formation. (Englisch, "Ent. Zeitschr.," Stuttgart, 1908, xxii., p. 55.)

The condition appears to be due to various unfavourable conditions, such as unsuitable food, starvation, cold, and weakness due to inbreeding.

NARROW SCALES.

Aglais urticæ. Both wings on the left side semitransparent. Scales very few and narrow. Much membrane visible between them. (Bright Coll.)

Cænonympha pamphilus. Wimbledon, 1919. Pale area near posterior margin of left forewing. Upper scales extremely narrow and normally pigmented, but showing the pale under scales. (H. B. Williams.)

Pararge ægeria. Two males bred from ova. Limber. Pale subdiaphanous patches on all four wings, which are incompletely expanded. Larvæ fed in closed tins in a warm room. Most of those bred were quite normal. Upper scales fully pigmented, but almost hair-like and tilted up at the extremity.

Pararge ægeria. All scales very narrow, showing membrane between. The cream-coloured spots appear greyish. Bred, C. Nicholson.

Rumicia phlæas. Wimbledon 26.viii.15. Larva starved by accident. Undersized male. All the scales are too narrow but not deficient in number. The black pigment is scanty at the ends of the black scales, and the orange pigment in the copper scales, giving both a pale appearance H. B. Williams.

ABSENCE OF HAIRS.

Aglais urticæ. A brood dull in colour, with no hairs on the body or wings. They were very weak, and died the day after emergence. ("Proc. South Lond. N. H. Soc.," 1887, p. 77.)

LOCAL ABSENCE OR DEFICIENCY OF SCALES.

Melitæa artemis. Posterior half of left forewing without scales; fringe perfect; sockets present. (Bright Coll.)

Polyommatus icarus, female. Small patch with no scales near termen; fringe normal. (Bright Coll.)

Agriades coridon, female. Large bare area near base of left forewing. Pale streaks radiate from this towards the termen. At the base scales are absent, sockets present; further out scales are present, but almost transparent. (Royston, Bright Coll.)

Euranessa antiopa. One forewing with no scales on under surface. (Rothschild Coll.)

Bupalus piniarius, female. An area along termen of left forewing near apex has no scales, but sockets are present. (H. Worsley Wood. Bred, Oxshott, 5.15.)

Rumicia phlaeas. A pale area runs from the disc between nervures 4, 5, and 6 to termen. Near the disc the scales are thin, transparent, and curled up, then there is an area without any scales extending to the fringe, where the scales are transparent. Scale sockets present. H. B. Williams. (Bexley, 8.09.)

Thecla w-album. The left forewing has three large stripes completely scaleless, one running along the posterior margin from the base almost to the termen. There were also four small patches without scales. Scale sockets are present. The line of division between the parts covered thickly with normal scales and the part which is bare is quite sharp. (Bred E.A.C., Horsley, 1919.)

Zygaena filipendulae. A large circular area over the corresponding parts of the left forewing and the left hindwing. There are no scales over the area in the forewing, and very few in the hindwing. (Brit. Mus.)

Epinephele jurtina, female. There is a hole through the wing near the base, cutting the median nervure in two, and two smaller holes close to the termen, between nervures 2 and 3. Just internal to these there is a scaleless patch with normal scale sockets. The rest of the interneural space is cream-coloured, and the scales are thin, transparent, and rolled up. (H. B. Williams, Chilterns, 8.1919.)

E. jurtina. Right hindwing has a piece scalloped out at the anal angle. From the base to this part of the wing there are no scales, except a few patches of transparent curled-up scales along nervures 1a and 1b.

Erebia eryphile, with round white area in both wings on one side, covered with thin rolled-up scales. In the hindwing there is a small round hole with no scales at all in the area around it.

Boarmia repandata, with a small patch placed symmetrically in each forewing without scales, but with scale sockets present. No other abnormality. (A. W. Mera.)

There can be little doubt that local injury is the cause of many of these scaleless patches. The association with holes in the membrane and with rolled-up thin scales is evidence of this. It is also supported by the cases in which scaleless patches in a fore- and hindwing of the same side coincide.

Local Scale defects.

I have examined a very large number of specimens showing patches of white or pale colour, often described as bleached specimens, and almost without exception have found the scales on these patches thin, transparent, or nearly transparent, and curled at the edges or rolled up completely. The condition very often affects corresponding areas on both wings of the same side, or on all four wings. As in the case of malformations, which appear alike in both wings of one side, or in all the wings, this affords strong evidence that local injury may be the cause. This is also supported by their association with holes in the wing or damaged nervures.

Direct evidence is given by Dr. Chapman, who accidentally pressed a pupa of *Pyrameis atalanta* between the lid of a jar and the glass edge, and left it for 24 hours. A deep impression was left across the wing case, which gradually became shallower. There was a bleached area across the red band of the forewing in the imago and some bleaching of the hindwing. ("Ent.," 1894, p. 23.)

Christeller, by exerting continuous pressure on pupæ of *Lymantria* (*Ocneria*) *dispar*, obtained, in addition to deformities of the wings and antennæ, scale defects local, and in one case general. ("Ent. Mitt.," 1917, vi., pp. 193-224.)

Katheriner found that one of the effects of extreme cold on pupæ of *Aglais urticæ* and *Euranessa antiopa* was the production of spots of albinism. ("Illust. Wochenschr f. Ent.," 1900, v., p. 321.)

Federley in his temperature experiments obtained specimens with symmetrical white spots, due to atrophic scales, and in one case had a specimen universally affected. ("Festschr. f. Palmén.," Helsingfors, 1905-1907, ii., p. 16.)

Englisch states that cold weather delayed scale formation, and probably produced atrophic scales in *Saturniidæ*. ("Ent. Zeitschr," Stuttgart, 1908, xxii., p. 55.)

Neither of these causes accounts for the condition in a brood of *Rumicia phlæas*, bred by Mr. H. B. Williams, in 1920, from Wimbledon eggs, Five females and two males had symmetrical pale patches near the middle of the posterior margin of both forewings, and one male had a similar patch on the left forewing only. The scales in all these were abnormal.

The larvæ were well fed under normal conditions and the pupæ were not touched, and were in positions where no pressure was possible. The imagines were large and the brood was a healthy one.

Dods reports a brood of *Ocneria dispar* in which many males had large asymmetrical white patches on the wings. They had been inbred for three generations from normal ancestors. He does not say under what conditions they were kept, but injury and abnormal temperature seem to have been unlikely causes. ("Proc. South Lond. N. H. Soc.," 1903, p. 74.)

I have found abnormal scales in the following species, with large white areas in the centre of all four wings, in several *Epinephele jurtina*, in *E. tithonus*, *Erebia goante*, *Cœnonympha pamphilus*, in *Brenthis epithore* with a round white area in both wings on one side; in *Argynnis aglaia* with small symmetrical white patches near the apices of the forewings, *Dryas paphia* with both hindwings whitish, and *Argynnis aglaia* with large areas of both hindwings nearly white.

The same condition was present in the forewings in *Melitæa athalia*, with the ground colour replaced by cream and the black markings by grey. The hindwings were normal. In one *Euchloë cardamines*, with a white streak running through the orange and black along the costa, a white spot in the orange and a white patch in the posterior part of the orange tip, and in another with all the black of the left forewing replaced by white; the same scale defect was present.

The same condition is present in a *Pararge megæra*, with the black part of both hindwings except the ocelli, replaced by cream colour, in two *Aglais urticæ* with symmetrical pale areas in both forewings, in a *Pyrameis atalanta* with a large part of the black of both fore- and hindwings replaced by pale brown, and part of the red band symmetrically pale on both sides. Canterbury. Specimens of *E. jurtina* with the whole of one forewing white showed extreme alteration of scales, and also showed evidence of injury near the base of the wing.

Many examples of *Rumicia phlæas* with patches of copper replaced by white, were in the same condition.

In the majority of the specimens examined it is easy to understand how local injury may be the cause, in others it is difficult to imagine that injury could produce the defect, for instance, in those in which both hindwings are affected and the forewings are normal.

In *Dryas paphia* it is not very unusual to find a white spot on all four wings, or on both the wings of one side, in which the scales of the ground colour are always defective, and sometimes those of the black spots also. The positions are nearly always the same, in the forewing between nervures 5 and 6, near the apex, and in the hindwing between nervures 4 and 5. These positions would coincide in the pupal condition. Local pressure is the probable cause, but it is hard to understand what the pressure can be which acts so uniformly on such a definite area.

In Heterocera local scale defects are fairly common. I have examined them in *Bupalus piniarius*, *Abraxas ulmata*, *Xanthia ocellaris*, and *Callimorpha dominula*. In the last species the glossy green forewings have dull and faded-looking patches with a pinkish colour, when the light falls at a certain angle. The scales are all thin, but some are partially pigmented and others transparent.

GENERAL AND SELECTIVE SCALE DEFECTS ASSOCIATED WITH DEFICIENCY OR ABSENCE OF PIGMENT.

Many well-known aberrations are pathological. In some all the scales are curled or rolled up, abnormally thin and deficient in or devoid of pigment. More often the scales forming one part of a simple pattern, or more than one part of a more complex pattern are quite abnormal, but the other scales attain to their normal development, or at the most are a little deficient in pigment. Cases are known in which in the same genus, and even in the same species, all the scales of one part of the pattern may be affected in one specimen and all the scales of the other part in another. One may call these complementary forms. Some of these are very rare, and all must be examined microscopically to prove the existence of a defect of the scales. I am greatly indebted to Lord Rothschild, Mr. P. M. Bright, and Mr. J. J. Joicey, for allowing me to examine the specimens in their collections, Mr. J. H Durrant for allowing access to the Bankes and Doubleday collections, and to Mr. H. B. Williams, Mr. H. Worsley Wood, Mr. R. W. Robbins, Mr. G. Talbot, and Mr. C. Nicholson, for their help.

RHOPALOCERA. — PAPILIONIDÆ. — *Parnassius*. The yellow-spotted aberrations of this genus are nearly all due to deficiency of pigment, associated with thinness and rolling up the scales. In species with white scales, in the centre of the spot. these are unaltered. Species which have blue scales in the black band near the margin, or in the black spots near the anal angle of the upperside of the hindwings, show even more marked changes in these scales, which are often shrivelled and colourless. The light-coloured scales forming the general ground colour are seldom abnormal, and the black ones are always normal.

The specimens in the British Museum, in the Hill Museum, and at Tring, given in the following list, all show well marked scale defects in the spots in which cream colour, yellow or orange, replaces the usual red colour.

Parnassius epaphus, Oberth., male, Kutie Pass, McArthur; female, top of Barren Mt., Thibet; female, Chonging Valley, *P. jacquemonti*, Boisd. Two males, Barra Larcha. Leech Coll. *P. sikkimensis*, Elw. A female, Sikkim, and a male. Walton. Sikkim, 1904, and two Yatung, Thibet. *P. styx*, Stgr. Orange spots with rolled scales, and blue scales also rolled up. *P simonius*, Stgr. Tartary. *P. hardwicki*, Gray. Four specimens with yellow scales rolled, two of them with blue scales shrivelled up, and another of them with some scales of the ground colour curled. *P. himalayensis*, Elw. Some blue scales curled up as well as the yellow ones. *P. actius*, Evers., male. Blue scales, thin and shrivelled. *P. acco*, Gray, female, Lupsang. *P. delphius*, Ev., Tian Chian, and a second specimen Elwes Coll., both of which have the blue scales altered as well. *P. delphius* ab. *namangana*, Stgr., male, Turkestan. *P. delphius*, Honr. f., *marginata*, female, Turkestan. Scales in yellow spots rolled to a point, and blue scales looking like colourless hairs. *P. orleansi groumi*, Oberth., *P. apollonius* f. *flavomaculata*, Aust., Mongolia.

P. imperator, Oberth., with large cream-coloured spots, in which the scales are curled up, and rather large blue spots, in which the scales are thin and rolled up.

P. apollo, L. Two females, Bignasco, 450-800 metres, and another Mergoscia, N. C. Rothschild, with curled-up orange scales. A male, Ragatz, 1903, has the yellow scales in the spots rolled up.

P. smintheus var. *behri*, Edw. Yosemite. All the scales of the pale ground colour are pigmented but curled up, those in the cream-coloured spots are very deficient in pigment and rolled up. Specimens of this local race, with yellow spots, which are in the British Museum, have normal scales, and it is probably a true colour variety. This specimen may be regarded as a defective yellow-spotted specimen, comparable to the defective red-spotted ones in the other species.

Since I examined these I find that Bryk has made the same observation about *P. apollo* var. *flavomaculata*, Deck., which he figures in his monograph (Taf., v., 30, and xi., 92). He also states that in the rare ab. *lamperti*, Bryk., in which the black part of the pattern is replaced by pale grey, the scales are deformed and very deficient in pigment (Taf., ix., 73). (Bryk., "Parnassius apollo," 1915, Berlin; reprinted from "Arch. f. Naturgeschichte," 1914, lxxx., Abt. A.)

Verity figures curled scales in the ground colour of *P. simo diaphana*, but does not mention them in the text ("Rhopalocera Palæarctica," pl. ii.)

Thais polyxena, Schiff. Kedos, Asia Minor, 18.v.18.

Thais cerisyi, God., male, Yozgat, Asia Minor, vi.18, and another, Mosul, ii.19, the former species with pink and the latter with yellow replacing red on the wings and abdomen. The scales in the spots are curled up, those of the pale yellow ground colour are rolled up and very thin, and in the specimen of *polyxena* the blue scales are transparent and rolled up. (Brit. Mus.)

Thais polyxena f. *cassandra*. Two specimens with transparent areas replacing the ground colour, and with creamy spots. The scales in the transparent parts are devoid of pigment and very distorted; in the spots the scales are rolled up and the blue scales are shrivelled up like hairs (Hill Museum). These are very like ab. *vitrina*, Rothsch. ("Nov. Zool.," 1918, p. 73.)

Thais rumina ab. *alba*, with white ground colour and cream spots instead of red, of which both sexes are figured by Esper, is probably due to a similar scale defect. ("Europaische Schmetterlinge," 1829, vol. i., Taf. cv., cont. lx.)

T. rumina var. *nebulosa*, Holl., shows the complementary condition. All the black markings are replaced by pale grey, and the scales are very deficient in pigment, thin and rolled up to a point. The scales of the yellow ground, red spots, and the pale blue ones scattered in the black border are all normal. (Rothschild Coll.)

T. rumina ab. *meta*, Meig., with cream-coloured spots, shows no abnormality of the scales in the five which I have examined, and is probably a true colour variety, due to a difference in pigment. *Alba*, Esp., is generally regarded as a synonym, but the white ground colour is very different from that of *meta*.

Thais polyxena ab. *albina*. Standfuss figures a specimen in which all parts of the pattern are very pale, and probably all the scales are pathological. ("Handbuch Paläarkt. Gross. Schmett.," Taf. iv., fig. 14.)

Armandia thaidina, Blanch., three females. Mow-pin 10,000 feet. In the cream ground-colour the scales are rolled a little, the inner red band of the hindwing is replaced by pink, in which the scales are pale and rolled up. The blue, the black, and the red scales in the lunules are normal.

Sericinus greyi, Brem., two males. N. China. Ground colour very pale and semi-transparent on the forewings with transparent distorted scales. Red markings replaced by pink, in which the scales are rolled up.

Sericinus fasciatus, Brem., three males and a female. Shanghai. Semi-transparent ground, due to transparency and extreme distortion of the scales. Red markings replaced by pink and with rolled up scales. In one the blue scales are rolled up.

Doritis apollinus, Hbst., three males, Smyrna. Hindwings transparent instead of cream-coloured and opaque. Scales devoid of pigment, thin, and rolled up. In two, orange curled scales and in one yellow, rolled up ones replace the normal flat red ones in the spots. The blue and black scales are normal. These are all in the British Museum.

In the genus *Papilio* scale defects seem to be as rare as they are common in the other Papilionidæ.

P. machaon, L., with pure white ground colour. Scales thin, rolled up, and transparent. Black, red, and blue scales normal. (Bright Coll.)

PIERIDÆ.—*Euchloë cardamines*, L. A male with all the black parts of the pattern white. The scales are extremely thin, transparent, and rolled up to a point in the parts which ought to be black on the upperside, and similar scales are scattered on the underside in the areas which are green normally but pale yellow in this specimen. The white and orange scales are unaltered (Webb Coll., now in the Bright Coll.). A male with pale buff replacing black shows diminution of pigment and a little curling of the edges of some scales. (Leech Coll., Germany, 1901.)

E. cardamines, L. Complementary form with the orange very pale and pinkish in colour. All the orange scales are thin, poorly pigmented and curled at the edges, the white scales are thinner and much more curled up (Elwes Coll.). In a similar but less extreme specimen from Petropolis, the orange and white scales are deficient in pigment, but they are much less curled up.

Hebomia glaucippe, L., Darjiling. A male with all the black on the upperside replaced by pale grey, and the dark brown of the underside by buff. The scales, in all four wings and on both surfaces, which ought to be black are thin, transparent, and rolled up to a point (Brit. Mus.). *H- bornensis*, Wall, Borneo. A male with scales rolled up and deficient in pigment. All the black markings replaced by very light brown (Hill Museum).

Delias aruna, Boisd., male. The normal male has a deep orange ground colour with black apices to the forewings, and a deep crimson base on the underside. Lord Rothschild has a specimen with cream-coloured ground and with the basal area pale pink. In these areas the scales are deficient in pigment and have curled edges. The black scales are normal.

NYMPHALIDÆ.—In the fritillaries aberrations with white or straw-colour replacing the usual tawny ground colour are well known, though rare. An example in *Brenthis euphrosyne*, L., is figured by Mosley, and one of *B. selene*, Schiff., by Barrett, "Brit. Lepidopt.," vol. i., pl. xxvi. Specimens of *B. euphrosyne*, L., in the Bankes and Bright collections, with a white ground colour, have all the scales of the upper layer devoid of pigment, very thin, and much rolled and twisted, those of the lower layer transparent but flat. The black scales are normal. Straw coloured specimens show similar changes, but not so extreme. Five examples of *B. selene*, Schiff., with white, or nearly white, ground in the Bankes and Bright collections, and a *B. amathusia*, Esp., with white ground (Elwes Coll., Brit. Mus.), a *Melitæa athalia*, Esp., with white ground (Bright Coll.), all show the same condition.

Dryas paphia, L. Maidstone, 1860, from Webb Coll., with white ground, and another, 1918, with cream-coloured ground (Bright Coll.), show the same thin, transparent, curled and twisted upper scales with transparent flat under scales. *Argynnis cydippe*, L., with light yellowish ground colour, has many scales transparent, thin, and rolled up, others normal and others intermediate. (Male, New Forest, 1919. Bright Coll.)

An *Issoria lathonia*, L., with white ground colour figured ("Iris," 1905, xviii., Taf. I.), and an *Argynnis aglaia*, L., with white ground colour, recorded from Halton, Bucks, by Goodson ("Entomologist," 1921, liv., p. 124), are no doubt similar pathological forms. In these specimens with a white ground colour the tawny scales on the abdomen are also replaced by white ones. Specimens of the complementary form, with the ground colour normal, or nearly normal, but with the black markings pale silver in colour, are very much rarer. *Argynnis aglaia*, L., var. *molybdina*, described by Newnham ("Ent. Record," 1917, p. 237, and "Ent.," 1917, l., pp. 207, 230), and a *Brenthis euphrosyne*, figured by Mosley, are examples.

I have examined two—an *Argynnis cydippe*, in Lord Rothschild's collection, and a *B. euphrosyne*, Barnwell Wold, 1864, in Mr. Bright's. In both of them the silvery scales are extremely thin, transparent, and rolled up to a point, but the tawny scales of the ground colour are normal. In the Vanessas both forms exist.

Aglais urticæ, L., with white ground colour (Rothschild's Coll.). The scales are very thin, transparent, and curled up, but the wing membrane is not exposed. The black scales are normal. Specimens with cream-coloured ground in the Bankes and Bright collections show similar, but less extreme, alteration.

Grapta c-album, L., Wye Valley. Two females and a male with the ground colour pale ochreous show deficiency of pigment. In the females some scales have curled edges, and in the male the curling is considerable. (Bright Coll.)

Pyrameis atalanta, L., with red replaced by pale cream colour, Gateshead ("Ent.," 1911, xliv., p. 363); *P. cardui*, L., with white ground colour, Boynton; *Grapta c-album*, L., with silvery white ground, Ganarew ("Ent.," 1922, lv., p. 92); and *Eugonia polychloros* ab. *pallida*, Tutt, with white ground colour, must belong to this group.

Complementary to these are *Vanessa* (*Grapta*) *c-album*, L., with the black on the upper surface replaced by silvery grey, and with the under surface pale ochreous, figured by Herrich-Schäffer ("Europaische Schmett.," 1843, vol. i., Taf. 35, figs. 159 and 160), and *Pyrameis atalanta*, L., from Berlin. Leech Coll., British Museum. This has all the black markings of the wings, thorax, and abdomen replaced by pale grey, but has the white and red areas normal. The upper scales in the grey part are all deficient in pigment, and rolled up to a point, exposing the flat under scales, in which the pigment is defective also. The change is greatest in the black dots in the red border of the hindwings. Owing to the even arrangement of the scales in this species the appearance under the microscope is very striking. The white, red, and pale blue scales are all normal.

Phyciodes tharos, Drwy. Black replaced by pale grey in a female figured by Edwards. ("Butterflies of North America," 1884, ii., pl. ii., fig. 13.)

Euvanessa antiopa, L. In specimens with a white or whitish border and costal markings the upper scales are deficient in or devoid of pigment, and rolled up. In extreme cases they are so thin and tightly rolled as to resemble hairs, and the under scales may be curled up at the edges. The blue scales may be curled or rolled up too. Out of 56 British specimens 47 had pale borders with defective scales, and ten had defective blue scales as well. The defect was found in specimens from Lapland, Switzerland, Alaska, California, and Central Asia. It seems to be common near the northern limit of its range and at high altitudes. ("Ent. Record," xxxiii., 1921, pp. 205-210.)

Vanessa io, L. Silver in colour round the ocellus and apical dots, and with a silver border; black costal markings dark grey. Ground colour normal, and posterior half of border in each hindwing unaffected. In the silver parts the scales are exceedingly thin, rolled up, and without pigment. Those in the black costal markings are less thin, have some pigment, and are less rolled up. (Caught 1854. Harper Coll.) Specimens from the Webb collection with symmetrical silvery appearance in part of the border of the forewings, show a similar defect.

SATYRINÆ.—The form of *Epinephele tithonus*, L., with a white ground colour is figured by Barrett ("Brit. Lepidopt.," vol. i., pl. xxxiv.). Eight with ground colour varying from white to chrome yellow were taken in 1900 on Portsdown Hill, by G. M. Russell, and are figured ("Ent.," 1904, xxxvii., p. 125). Those with white ground colour, ab. *albida*, Russell, show extreme thinness and rolling up of the upper scales with absence of pigment, those with cream-coloured ground, ab. *subalbida*, Verity, and with chrome yellow ground, ab. *mincki*, Seebom., show similar but less extreme alteration. I have examined Russell's specimens now in the British Museum, and one ab. *albida* in the Bright Collection. The complementary form with the black part cream-coloured and the ground colour unaltered, is known.

In *Epinephele jurtina*, L., a form with white ground colour is found, ab. *pallens*, Mieg. One is figured by Oudemans ("Tijdschr. v. Ent.," 1905, xlviii.), and another by Barrett ("Brit. Lepidopt.," vol. i., pl. xxxiii.). In a male in Mr. H. B. Williams' Collection, in two females in Lord Rothschild's, and two in Mr. Bright's, the lower scales are flat but devoid of pigment, those of the upper layer are very thin, unpigmented, and rolled up. The scales on the dark brown part of the wing and ocellus are normal.

The complementary form, ab. *brigitta*, Ljungh., in which the tawny ground colour is normal, the black part of the ocellus replaced by pale grey, and the dark brown part of the pattern altered to white or cream colour is very much rarer. A white one is figured by Esper ("Europaische Schmett.," vol. i., Taf. lxxxii., cont. xxxii.). A female in Mr. R. W. Robbins' possession, and another in Mr. Bright's, have the scales of the ocellus poorly pigmented and rolled up, the upper scales of the creamy part thin, transparent and rolled up, the lower scales transparent but flat, and the tawny scales normal. Males and females with the whole of the wing pale have a general deficiency of pigment, with curling of some scales in all parts of the pattern.

Satyrus semele, L., with white ground colour has the upper layer of scales thin, transparent, and rolled up, the lower layer transparent but flat (Bright Coll.).

Satyrus arethusa, Esp., ab. *albina*, Oberth., with the deep brown replaced by pale yellowish grey is probably a complementary form ("Études. Ent.," 1896, xx., pl. ii., fig. 11).

Pararge megæra, L., with silvery white ground colour. Scales excessively thin, rolled up so as to resemble coarse hairs, and unpigmented. Scales of dark part normal. (Somerset. Bright Coll.)

P. megæra ab. *pallescens*, Oberth., and *P. hiera* ab. *pallescens*, Oberth., with the black parts pale cream or greyish, are figured in the "Études. Lep. Comp.," 1912, vi., pl. cxxiv.

P. egeria ab. *albescens*, Oberth., with black replaced by buff, shows great deficiency of pigment, but few scales are curled. (Bright Coll.) These are complementary forms.

In *Erebia* both forms of scale defect seem to be rare.

E. epiphron ab. *albinescens*, Oberth., male and female with red-brown replaced by cream or palest chestnut, black part normal. ("Études. Lep. Comp.," 1911, v., pt. i., pl. lxxiii., figs. 667 and 672.)

E. tyndarus ab. *albana*, Oberth., has the red-brown markings on both surfaces replaced by white. ("Ét. Lep. Comp.," 1912, pl. cxxiii., fig. 1904.) *E. medusa* pure white replacing red-brown. ("Ent. Zeitschr. Guben.," 1894, viii., p. 134.)

The complementary forms with the black replaced by cream or pale grey are described and figured by Oberthür.

E. lappona ab. *albina* ("Ét. Lep. Comp.," 1911, v., pl. lxxiii., fig. 671), *E. æthiops* ab. *huebneri*, *E. euryale* ab. *huebneri*, and *E. ligea* ab. *huebneri* ("Ét. Lep. Comp.," 1912, vi., pl. cxxiv.).

Œneis semidea, Ev. Two females with white ground colour instead of buff. Upper scales curled at the edges. (Hill Museum.)

In *Cœnonympha pamphilus*, L., deficiency of pigment appears to take place with little reduction in thickness of the scales. Only the whitest specimens from Royston, in Mr. Williams' Collection, and similar ones in the Bright and Doubleday Coll., show any curling of the scales. A corresponding form, *C. arcanius* ab. *dupuyi*, Oberth., is figured in the "Etudes.," 1910, iv., pl. xxxvii.

Melanargia galatea, L., with black replaced by buff, Monk's Wood, has deficient pigment but no deformed scales. Two similar specimens from Worcester have many scales curled both in the white ground colour and in the buff part. (Bright Coll.)

ERYCINIDÆ.—*Nemeobius lucina*, L., male. Chilterns, Bright Coll. With creamy ground colour has many scales deficient in, or devoid of, pigment and curled or rolled up. All the black scales are normal. Lord Rothschild has the complementary form with the black part of the pattern replaced by pale grey, and in this these scales are poorly pigmented and rolled up, but the others are normal.

LYCÆNIDÆ.—In *Chrysophanus* and its close allies, the colour is, according to Onslow, due to an orange pigment, and the brilliant metallic lustre is caused by the highly polished surface of the scale.

Rumicia phlæas ab. *alba*, Tutt, with a white ground colonr is not very uncommon. I have examined about a dozen, all of which have flat, transparent under scales, and thin transparent rolled up upper scales. The scales in the black part of the pattern are normal. The ab. *schmidtii*, Gerh., is very similar, but some of the scales have a little pigment in them.

In ab. *intermedia*, Tutt, some of the scales are almost normally pigmented and quite flat, others deficient in pigment and curled or rolled up.

The complementary forms are extremely rare.

The ab. *hübneri*, Tutt, named from a specimen taken near Berlin, figured by Hübner, has the black parts white, the copper parts normal. The ab. *webbi*, Tutt, taken at Reigate, figured by Mosley and Barrett, has the black spots pale grey, and the black border replaced by cream colour. Mr. Bright allowed me to examine it, and I found the lower layer of scales thin, partially transparent and curled, and the upper layer exceedingly thin, transparent and rolled up to a fine point. Those in the spots are thin and rolled up, but have some pigment. A specimen from Dover with black replaced by grey merely shows deficiency of pigment.

Oberthür describes and figures *Chrysophanus gordius* ab. *albescens*, male, Grisons, *C. virgaureæ* ab. *virginalis*, male, Silesia, with white ground colour. *C. chryseis* ab. *hermathion*, male, Silesia, corresponding in colour to *R. phlæas* ab. *schmidtii* and *C. virgaureæ* ab. *chryzon*, with pale yellow ground, male, Frankfort-on-Maine, in his "Études.," 1910, iv. The last appears to be very like ab. *onka*, Fruhst. He also says that he believes there is an aberration of *C. virgaureæ* in which the copper remains normal, but the black border and spots become white ("Bull. Soc. Ent. France," 1905, p. 56).

In the "Blues" the arrangement of the scales makes similar scale defects present a different appearance. On the upperside there are three different sets of scales in the pattern, which may be affected independently: the upper scales, which are blue owing to their physical structure, the under scales which are deep brown or black, and the orange scales of the lunules. I described and figured the pathological scales of the upper layer, which become transparent, thin, and rolled up, allowing the black of the under layer to be seen through and between them, giving them a leaden colour. ("Trans. Ent. Soc. Lond.," 1917, p. 165.)

I have examined twenty more or less leaden-coloured males of *Agriades thetis* in the British Museum and Bright Collection, and two females taken by Dr. Nash in May, 1921, at Wye, which have leaden instead of blue markings. I have looked at eighteen males of *A. coridon* under the microscope, specimens from various British localities and one from Holland (Godman-Salvin Coll.), two leaden females ab. *syngrapha* from the Chilterns, and a dull leaden female ab. *semisyngrapha*, Tutt, taken by Dr. Nash at Royston, in 1917. All these show the same defect, rolling up and transparency of the upper scales. I have also examined a specimen of *A. thetis*, with the forewings leaden and the hindwings normal, and one with all the wings leaden except for a bright blue border of uniform width, and several partly leaden partly blue. These had the upper scales in the leaden areas similarly defective. In the general collection of the British Museum there are examples of the following species with the same abnormality of the upper layer of scales.

Polyommatus hylas, Esp., male. N. Spain. Wrongly labelled ab. *nivescens*, Kefers. The scales in *nivescens* are flat and of normal thickness, and the insect is brighter and whiter than this pale leaden one. *Hirsutina dolus*, Boisd. A male, more lilac-coloured than usual. S. France. (Godman-Salvin Coll.) *Polyommatus mesopotamica*, Staud. Two extreme leaden forms, Malatia (Leech Coll.), and one less marked example, Malatia (Godman-Salvin Coll.). *Polyommatus pylaon*, F. de W., male, Steppes, S.E. Russia (Zell. Coll.). *Everes polysperchon*, Berg. Several males and females, a male of *E. argiades*, Pall., and several *E. coreias*, Ochs. *Cyaniris argiolus* var. *hugelii*, Moore, male, Kobe, Japan. (Scarlett, 23.vi.1900.) *C. argiolus* var. *lucia*, Kirby, female, Nebraska. (Crowley Bequest.) *Argiolaus lalos*, Druce, male. A leaden colour replaces the deep metallic blue. Upper scales thin, transparent, and in many cases rolled to a point. Lower scales and scales of orange anal spots normal. In the females of *A. thetis* and *A. coridon* the scales of the orange lunules are nomal, and in all species the underside is unaffected.

Mr. Bethune-Baker showed a number of examples of *Agriades thetis*, *A. coridon*, *A. escheri*, *Polyommatus hylas*, *P. icarus*, *Plebeius argus*, L., and *Cyaniris argiolus* at the Entomological Society of London, in March, 1921, and stated that the leaden colour was due to the same defect. He said that throughout Provence, where they were taken in 1920, a fine sunny year, 15% to 20% of all the blues were leaden. All the *hylas*, about a dozen of which were seen, were of this colour.

The complementary form, in which the under scales are pathological, has a pale semitransparent appearance in the blue part of the wing in the males, and, when the pigment is entirely absent, there is a pale grey border with a slight bluish iridescence. There are two males of *A. coridon* like this in the Bright Collection, both taken at Royston, in 1920. They show transparency and curling of the scales of the lower layer and border, but the blue scales and androconia are normal. A third specimen is similar, but some of the blue scales are curled at the edges. When the change is less complete and some pigment is present, the border is a pale khaki colour, and a tinge of this shows in the blue part.

I have examined males of this form in the Bright Collection from Dover and Royston, and one continental specimen from the Feisthamel Collection (Hill Museum).

In the female the absence or scarcity of blue scales allows the khaki colour to show all over the wings in specimens with some pigment, and in those with little or none there is a pale grey colour with a bluish iridescence, but the scales are not rolled up to a point.

I examined the following females:—*A. coridon*, khaki colour; few scales curled; two with bluish iridescence; most of the scales curled. *A. thetis*, pale khaki, orange lunules normal. Scales very thin and many curled up. Many normal blue scales present. Torquay, 1842. *A. thetis*, two pale greyish brown females with deep orange lunules. Curled scales fewer in number. Normal blue scales present. Folkestone, 1887. *Plebeius argus*, L., female. Khaki-coloured with bluish iridescence. Scales very thin, transparent, and curled at edges. New Forest. *Cupido minimus*, Fuessl., khaki male. Pigment very deficient, some scales curled. Blue scales normal. (Bright Collection except one *Coridon* female, Williams Coll.) *Cupido persephatta*, Alpheraky. A very pale buff-coloured female with thin transparent scales rolled up to a point, or curled at the edges. (Brit. Mus.)

In the leaden ab. *syngrapha*, and in khaki females of *coridon* and *thetis*, the scales in the orange lunules are normal. *Lycænidæ* with defect of the upper scales, are much commoner than those with defect of the under scales.

Specimens with pathological scales in the lunules appear to be rarer than either of the two other groups. *Aricia medon*, Hufn., female with white lunules on all four wings. The scales of lunules show extreme thinness and transparency, and are rolled up to a point. At the edges of the lunules single normal blue scales were seen and the dark brown scales were all normal. (Newman, Folkestone, 1920, Bright Coll.) Wright records this aberration of *medon* and says it is var. *graaji*, ver Huell, three or four of which have been taken in Holland. ("Ent.," 1922, lv., p. 111.) *Plebeius argus*, L. Three females with white lunules. One from Dover shows extreme alteration of these scales in all four wings, the other from North Kent shows less alteration of the scales in the lunules of the forewings (Bright Coll.). The third is a gynandromorphous specimen with the wings on one side small and liberally sprinkled with blue scales, which, like the dark brown ones, are unaltered.

From this account it will be seen that any one of the three sets of scales may show these pathological changes without any abnormality occurring in the two other sets. The androconia are unaffected both in leaden and khaki blues.

GRYPOCERA.—*Nisioniades tages*, L. Bucks, Chilterns, 1918. Pale grey specimen with upper scales very thin and curled or rolled up. (Bright Coll.) *Adopaea linea*, two males with silvery-white ground colour, in which the scales are extremely thin, transparent, and curled or rolled up. Scales of sex brand and black border normal. This is the ab. *ardens*, Esper. A similar form of *A. lineola* ab. *ardens*, Oberth., is figured in the "Études," 1910, iv., pl. xxxvii., and it is known in *Augiades* (*Erynnis*) *comma*, L. Cruikshank has taken an *Augiades sylvanus*, Esp., in Hampshire with all the tawny colour of the wings and abdomen replaced by white. ("Ent. Rec.," 1922, xxxiv., p. 16.) The complementary forms which retain the tawny ground colour, but have the sex brand and border replaced by pale greyish ochreous are *A. linea* ab. *antiardens*, Oberth., and *A. comma* ab. *albescens*, Oberth., figured on the same plate. The latter aberration is also figured by Barrett and Mosley. Mr. Bright has a specimen of *A. comma*, a female, with the black part of the pattern silvery-grey, and here the scales are very thin, transparent, and rolled to a point, those in the tawny part are all well pigmented, but a few are a little rolled up at the tip. According to Oberthür all the species of *Syrichthus* may have black replaced by pale grey, and he figures an example in *S. malvae*, L., under the name ab. *albina*, on the same plate as the aberrations discussed above.

HETEROCERA.—*Triphaena fimbria*, L. Two specimens with the orange of the abdomen and hindwings replaced by white, the black band of the hindwings and the colours of the forewings remaining normal. The hindwings in this species are very hairy, but where the scales are visible they are seen to be very thin, transparent, and rolled up. (Folkestone, Bankes Coll. and Rothschild Coll.)

T. pronuba, L. Holland, Swansea, Bankes Coll. The specimen is figured in Barrett's "Brit. Lepidopt.," vol. iv., pl. 140. It looks as if sprinkled with grey powder. The black bands on the hindwings are pale grey, and the scales are very thin, rolled up, and transparent. Over the rest of the insect there is some deficiency in pigment and curling of the edges of the scales. A similar specimen was bred from a pupa found at Tarvin by Mr. Gordon Smith, who tells me that many of the scales were defective. ("Records and Observations of British Lepidoptera," S. Gordon Smith and E. Nevill Wilmer, Chester, 1922, p. 25.)

T. comes, Hubn., Dover. Bankes Coll. The insect is almost uniformly cream-coloured. The scales are all very deficient in pigment, and many are curled up.

Taeniocampa gracilis, Fab. Hon. N. C. Rothschild, Wood Walton Fen, Hunts, April, 1913. Several pure white specimens were captured, of which a pair are in the British Museum. All the scales of both fore- and hindwings are transparent, some are flat, others curled or rolled up.

Mamestra brassicae, L. C. Nicholson, captured at sugar, Clapton. The markings are almost absent and the wings have a glossy appearance. Many scales are transparent and some curled inwards at the edges.

Probably the very pale specimens of *Noctua augur* and *Taeniocampa stabilis*, View., figured by Barrett, vol. iv., pl. 141, and vol. v., pl. 209. are similar pathological forms.

Catocala nupta, L. Oudemans gives a coloured plate of a specimen with the black band on the hindwings replaced by pale grey, and figures the rolled up scales. (" Tijdschr. v. Ent.," 1896, xxxix., p. 167.)

Zygaena trifolii, Esp. Red on all four wings replaced by white. Scales thin and rolled up. T. H. Grosvenor, Sussex, 1921.

Callimorpha dominula, L., with the red colour of the hindwings and abdomen replaced by pure white, the rest of the pattern remaining unaltered. These scales are devoid of pigment, thin, and rolled up. (Rothschild Coll.)

Callimorpha quadripunctaria. Germany. Red of hindwings and abdomen replaced by white, due to a similar but less extreme scale defect. (Joicey Coll.)

Cosmotriche potatoria, L., female (Rothschild Coll.), *Dasychira fascelina*, L. (Bankes Coll.). White forms with transparent scales, which are very narrow, and in consequence show with little curling.

Opisthograptis luteolata, L. White aberration (British Museum). Scales unpigmented and non-fluorescent. Comparatively few are curled.

Standfuss states that two albinistic larvæ, one of *Arctia caia*, the other of *Dendrolimus pini*, gave albino imagines, the rest, which were of normal colour, gave normal imagines. (" Handbuch Palaarkt. Gron. Schmett.," p. 201.)

We know nothing about the cause of these defects, which even in the same species may in one specimen affect one part of the pattern and in another may affect another part. If the same agency is at work in all cases, it is difficult to understand how this can happen, unless the development of the scales in one part of the pattern takes place at a slightly different period from that of the scales in another. There is no evidence that it is dependent on climate. Specimens come from the arctic and the tropics, from sea level and high altitudes.

They are commoner in some years than in others, and in some localities than in others. At Royston, for instance, several *Coenonympha pamphilus* ab. *pallida* were taken, and leaden and khaki forms of *Agriades coridon* occurred in greater numbers than usual in 1920, a cool damp year. Whereas in the same year leaden blues were quite common in Provence, where the season was very dry and sunny. Leaden *A. thetis* seem to be commoner at Folkestone and Swanage than elsewhere, and at the latter place Mr. Worsley-Wood tells me he took twenty in one year without much trouble.

Many of these aberrations have been taken in the Chilterns. A number in Mr. Bright's collection come from this locality, and Goodson records a number from the neighbourhood of Tring in the "Entomologist," 1921.

Allen reports the capture of four of the rare white form of *Brenthis selene* in one day, in Wyre Forest ("Ent. Rec.," 1916, xxviii., p. 16). The only species in which defective specimens are commoner than normal ones is *Euvanessa antiopa* from Arctic Europe and America. Apparently five out of every six are defective towards the northern limit of its range. One is inclined to put this down to the more rigorous climate, but heat and cold experiments have not produced it, although it is a species which has been used frequently.

If bacteria or some other infective agent is the cause, we should expect it to be commoner in bred specimens; but nearly all the specimens are captured and are full-sized, and perfect in every other respect. Mr. Richards bred a *Rumicia phlaeas* ab. *alba* with several hundred normal specimens, and tells me the larvæ were very free from disease. In 1919 I bred some *Pararge megaera* from the egg, in a warm room in a closed tin. One which failed to emerge had a pure white ground colour. The temperature was equable and the box was always moist, but the grass was kept sometimes until it had begun to turn yellow. There seems to be no common factor which causes the defect. It is possible that the condition is hereditary, and comparable to hereditary defects of the epidermis found in birds and mammals, including man. It is due to some general condition acting from within or from without. The areas affected on the two surfaces of the wing are frequently different, a sharp contrast with local defects in which they always coincide, and thoracic and abdominal scales are often defective, as well as those on the wings.

A scale defect, which differs from the one just mentioned, affects the ground colour, sparing the black markings. It is particularly common in *Vanessidae*, especially in *V. io*. Most of the scales have the distal half, or two-thirds, twisted into a tight spiral, so that they resemble coarse hairs. In some scales the spiral is less tight, in others the distal half is merely bent over. In the most marked examples the scales appear to be reduced in number, and both upper and under scales are altered, so that the wing membrane is visible. Pigment is always present, but is sometimes duller and more violet than usual. It may be diminished in amount, and the scale may be unduly thin, especially in the distal part. Tho scales may stand upright or have the distal part upturned.

In *Vanessa io*, L., this abnormality gives the insect a dull violet tint and a semitransparent or greasy appearance. In some specimens the base of the wing is very nearly normal. In *Aglais urticae*, L., the cream markings near the costa are less altered than the fulvous part, which is a dull violet colour.

In *Pyrameis atalanta*, L., the red colour appears dull and semitransparent, and in *Grapta c-album*, L., the colour is dull violet. This condition in *A. urticae*, with upturned, pigmented, hair-like scales, showing the wing membrane between, affords a striking contrast with the white variety of the same insect, with all the scales transparent and devoid of pigment, but without any exposed wing membrane.

In *P. atalanta* the scales of the white dot, which lies in the red band of the forewings, are normal, and show up conspicuously amongst the tightly twisted red ones.

I have examined four *P. atalanta* (Bright Coll.), six *V. io*, six *A. urticae*, and one *Grapta c-album* (Miss Vivian, Shropshire), with this defect.

Almost all similar specimens are bred, and it is possible overcrowding of the larvæ in closed boxes may be the cause. It is stated that a number of *V. io* were bred with scales replaced by short red hairs, giving the wings a glazed appearance. The larvæ were crowded together and perspired much. ("Ent.," 1878, p. 186.)

Apart from the *Vanessidae* I have seen this defect in *Papilio machaon*, with the ground colour dull brown and semitransparent. The scales were upturned, twisted into tight spirals, and the membrane was exposed. (Bright Coll. Figured in Mosley's Illustrations.)

I have also seen it in *Erebia aethiops*, Esp. Three males taken in Dumbartonshire, in 1921, had the red-brown replaced by dull violaceous colour, and these parts of the wings were semitransparent. The lower layer of scales on both surfaces in these areas were abnormally coloured, and some were curled at the edges. The upper scales were nearly all twisted into spirals, most of them so tightly as to resemble hairs in the distal half, others more loosely. Some were merely turned over so that the distal part had its lower surface uppermost. The black scales and the white scales of the ocelli and of the under surface of the hindwing were normal. Every scale which is usually red-brown on all four wings, and on both surfaces, was abnormal, but no wing membrane was visible.

A similar aberration of *Erebia ligea* ab. *livida*, Oberth., male, is figured ("Études. Lep. Comp.," 1912, vi., pl. cxxiv., fig. 1098) and described (ibid, 1909, iii., p. 331) as "brun pâle livide," and on page 329 an aberration of *E. euryale*, Esp., of the same colour is mentioned.

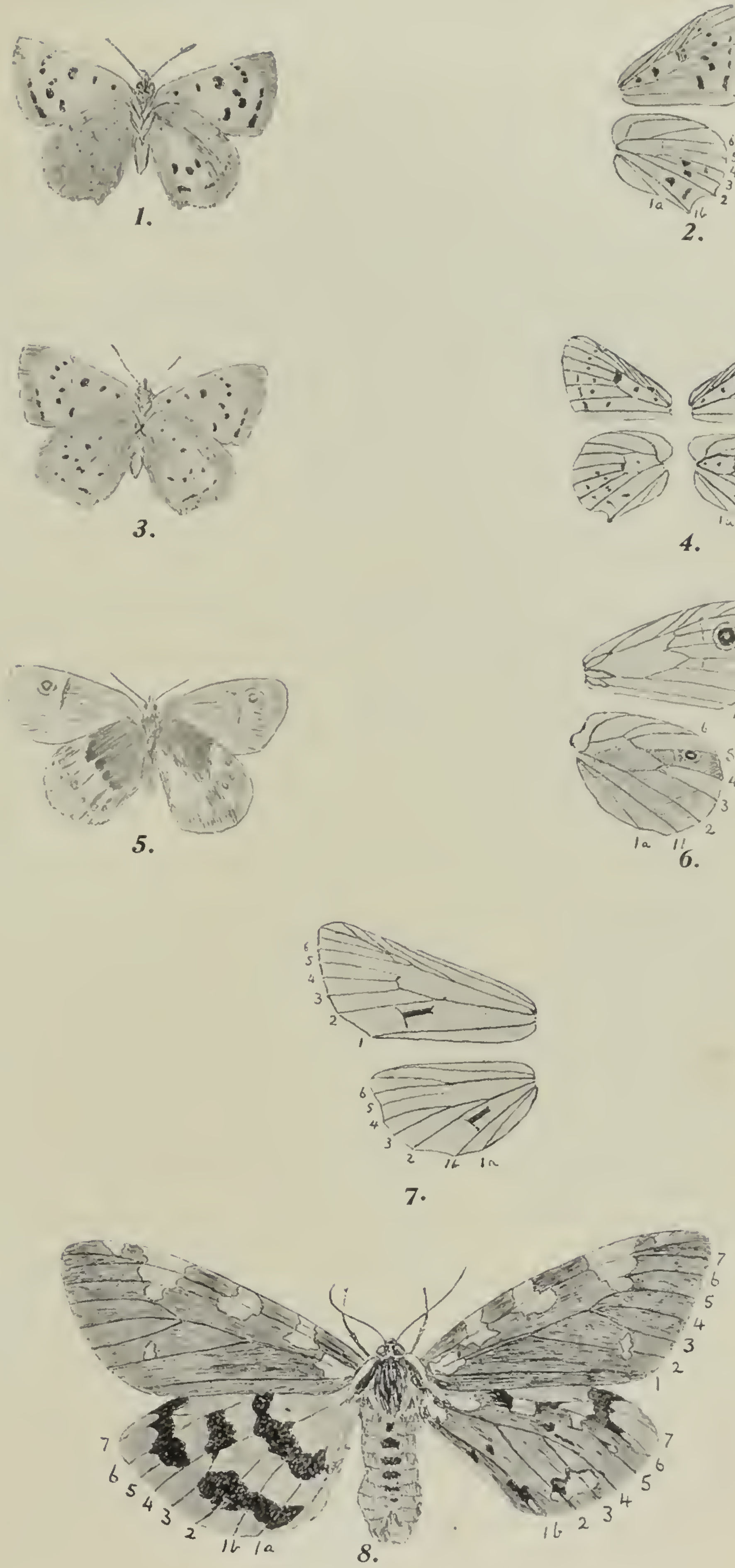
Mr. H. Worsley-Wood tells me there is a similar aberration of *E. aethiops* in the Massey collection, with spirally rolled scales. It was taken by Reid, at Forres, in 1884.

A similar *Erebia aethiops*, Esp., is figured by Ernst. ("Papillons de l' Europe," 1779, vol. ii., pl. lxv., fig. 43h).

Two specimens of *E. ligea*, L., with the rusty band and spots replaced by violet grey, were taken at Bjorkliden, Lapland. (Rosa, "Ent.," 1921, liv., p. 281.)

Unclassified scale defects.

A *Vanessa io*, L., with a yellow-brown ground colour, dusted with silver, shows a general deficiency of pigment. The silver dusting is produced by scales which are turned out sharply at the middle, so that



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Some Examples of Homœosis.

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their undersides lie uppermost and reflect the light. The ends of these scales lie quite flat and show the striæ clearly. (Bright Coll.)

Colias vautieri, Guér., Coquimbo, male. The underside, costæ, posterior borders, and nervures on the upperside of all four wings, have normal scales. The rest of the upperside has, on the forewings, a pinkish scaleless appearance, and on the hindwings a creamy colour, instead of the usual deep orange. The upper scales in the abnormal part all have their edges tightly rolled over, and look like thick hairs. Many of those in the forewing are fully pigmented, those in the hindwing are deficient or lacking in pigment altogether. The under scales are very pale, but not deformed. (Adams Coll.)

Pieris brassicae, L., with white ground colour brownish. The scales are set vertically, and bent and twisted in all directions. They appear white under the microscope (Bright Coll.). Lord Rothschild has a much darker specimen with a similar scale defect. The black parts appear to be unaltered.

Arctia caia, L., Germany. The scales of the white part of the pattern are all arranged in an abnormal manner. Many are set vertically, others sideways, and the scales themselves are bent and twisted in all directions. They contrast sharply with the brown scales, which are all arranged in an orderly way, though tilted upwards a little more than usual. Much wing membrane is exposed in the white areas, none in the brown. The red scales in the hindwings are a little deficient in pigment, and the edges are slightly curled up, but the general arrangement is regular. (Leech Coll.)

Abraxas sylvata, Sc., pale brownish subdiaphanous. All the scales are narrow, too few in number, and curled in various ways. (J. Maddison, Durham.)

Cyaniris argiolus, L., female, with general colour pale and with black tips. Khaki coloured. Deficiency of black pigment. Many blue scales much curled at edges.

Automeris gayi, Lucas, Chili. Underside normal. Deep metallic blue of upperside replaced by shining steel-grey. All the scales seem to be bent sharply upwards, so that the extremeties point vertically upwards. Under the microscope the tips look like rows of tiny silver beads. (Joicey Coll.)

ABNORMAL SCALES WITH ABNORMAL PIGMENT.

Argynnis cydippe, L., male. Dusky ground colour. Many scales partly transparent. The pigment in the others must be abnormally dark.

Argynnis aglaia, L., N. Cornwall. Dusky ground colour. Some scales are deficient in pigment and curled up. The pigment present must be abnormal.

Limnas chrysippus var. *inaria*, Mombasa, 13.vi.1888. Dull brown instead of chesnut. Scales curled here and there all over the wings. A specimen with white hindwings, Old Calabar, 1901. Chesnut altered to a dull brown. Scales in the anterior part of the forewings all transparent, curled up and twisted, some bent over on the rest of the surface. Another similar specimen has the defect of scales less pronounced, but the colour is the same. (British Museum.)

Catocala nupta, L. Red of hindwings replaced by deep brown with a violet iridescence. The scales are deeply pigmented, and many have the tips turned upwards and transparent. This gives the violet iridescence, which is not at all comparable to that of *C. fraxini*. In the normal hindwing all the scales are red, and there are no dark under scales.

Callimorpha dominula, L. I have a typical specimen and two var. *rossica* with a brown patch in the centre of each hindwing. These scales are full of dark abnormal pigment, their ends are upturned and rolled up.

I have been unable to examine the form of *Arctia villica* with dark brown hindwings.

IMPERFECT EXPANSION OF WINGS.

Crippling, as it is commonly called, is to a great extent due to unfavourable external conditions. Unduly dry atmosphere seems to be the chief cause, and explains why it is common in captivity. The *Hybernias* are especially liable to emerge and develop imperfectly in captivity, and *Aglia tau*, according to Lord Rothschild, is a species difficult to breed perfect. In these remarks I am taking for granted that the insect is able to climb to a suitable position to expand its wings. Weakness of the insect itself also plays a part.

From a pupa of *Arctia caia* a crippled imago and an ichneumon fly emerged. ("Ent. Month. Mag.," 1852, p. 78.) Many extreme aberrations are particularly liable to crippling both in captivity and under natural conditions. Black aberrations of *Arctia caia* and *Callimorpha dominula* may be cited as examples. Many of these aberrations are probably pathological.

The best evidence on this point is afforded by *Abraxas sylvata*. This species was very common near York one year, and there were many leaden forms and some asymmetrical. Most of these were crippled, and some lacked hindwings. ("Proc. Ent. Soc. Lond.," 1897, p. xlix.) Tutt discusses the question and thinks that they are pathological. He points out that in most years they are rare, but on this occasion were very common. ("Ent. Record," 1897, ix., pp. 305-307.)

Abraxas sylvata leaden forms were perfect, but the number of crippled intermediates was astonishing, chiefly on the left side. (Walker, "Ent. Record," 1899, xi., p. 24.) The scales in the leaden form are perfect, and the defect appears to be pigmentary. Probably it is not hereditary, and certainly it is not a Mendelian dominant like most melanic geometers. Ova from the leaden form gave nothing but typical specimens. ("Ent. Record," 1901, xiii., p. 297.)

Hygrochroa syringaria. Buckstone bred a number all with narrow or shortened wings, and some crippled as well. The male parent was normal, but the female was crippled. He considers that their front legs were weak, which would account for the crippling of some of them. ("Proc. South Lond. N. H. Soc.," 1918-1919, p. 104.)

Homœosis. Mr. Worsley-Wood tells me he has bred a *Brephos parthenias* with a stripe of the orange of the upperside of the hindwing on the upperside of the forewing. (Wimbledon, 1922.)

Macaria notata with repetition of the compound spot of the forewings upon the hind. Purdey, Folkestone. (Barrett, "Brit. Lepidopt.," vi., p. 375.)

These appear to be the only examples of homœosis in Geometridæ.

Segmental defect. *Himera pennaria* with one antenna inserted above the eye and the other below the eye. (Pierret, "Bull. de la Soc. Ent. de France, 1847," ser. 2, v., p. lxxxv.). This was probably displaced by injury like the more remarkable example in the Homopteron, *Carineta formosa*, Germ., which had a full-sized leg on its head and a foreleg missing from the thorax. ("Ent. Zeitung. Wien," 1906, xxv., pp. 261-262.)

Hypertrophy. *Agrotis exclamationis* with very long claw to the left hind leg. ("Proc. South Lond. Ent. and N.H. Soc.," 1909, p. 112.)

EXPLANATION OF PLATE I.

Examples of Homœosis.

Fig. 1. *Rumicia phlæas* with patch of underside pattern of forewing on underside of left hindwing.

Fig. 2. Same specimen showing relation of spots to nervures.

Fig. 3. *R. phlæas* with underside pattern of forewings on underside of both hindwings.

Fig. 4. Same specimen showing the homology of the spots in the abnormal hindwings to those in the forewings.

Fig. 5. *Cœnonympha pamphilus* with underside pattern of forewing on underside of left hindwing. A. W. Mera.

Fig. 6. Same specimen showing relation of pattern to nervures.

Fig. 7. *Tæniocampa gothica* showing that the forewing marking on the upperside of the left hindwing bears the same relation to nervures as the normal upperside marking of the forewing.

Fig. 8. *Pericallia matronula* showing the relation of the abnormal forewing markings on the right hindwing to the nervures.

REPORT ON THE BIRDS OF EPPING FOREST FOR THE YEAR 1921.

The Sixth Annual Report is appended hereto. The number of records received has been well maintained, but it is unfortunate that certain districts still remain largely unrecorded ; Wanstead Park and Flats, Leyton Flats, Walthamstow and Woodford Forests, Lords Bushes and the Lower Forest having received little or no attention. Records from these districts are badly needed. The total number of species recorded is now 96; the four following species having been added during the year, *viz.*, Little Owl, White Wagtail, Grasshopper Warbler and Curlew. We continue to receive valuable help from several non-members of the Society and we would especially thank Mr. V. G. Davey of Loughton for important additions to our Forest records. As before, all records should be sent to the Secretary of the Section, Mr. S. Austin, 43, Darenth Road, Stamford Hill, N. 16.

Carrion Crow (*Corvus corone*).—Well distributed over Forest. A number of nests seen.

Jackdaw (*Corvus monedula*).—Frequently recorded. Nested at Golding's Hill (June) and Warren Hill (July).

Rook (*Corvus frugilegus*).—Seen throughout the year on open spaces. A favourite roosting place is near King's Oak, High Beach. Mr. F. F. McKenzie, Forest Superintendent, reports as follows on the Wanstead Park Rookery for 1921 :—"Although the Park is full of these birds during winter and spring, very few nests have been built recently, not more than a score this year. This may be the result of precautions taken against their nesting in the Heronry."

British Jay (*Garrulus glandarius rufitergum*).—Appears to be more common. Several nests found.

Starling (*Sturnus vulgaris*).—Recorded commonly throughout year. Flocks of about 100 birds seen June 11th.

Greenfinch (*Chloris chloris*).—Commonly recorded except during the nesting period. Young birds being fed at Loughton, September 7th.

Hawfinch (*Coccothraustes coccothraustes*).—Numerous records throughout year. Three nests, Warren Hill, third week April; seen feeding on fruit of service tree during September.

British Goldfinch (*Carduelis carduelis britannica*).—Flock near the Warren, January 16th ; Staple's Hill, December 18th.

House Sparrow (*Passer domesticus*).—Recorded from suitable places.

Tree Sparrow (*Passer montanus*).—Gilwell Lane, two, April 3rd ; Chingford Wood, April 3rd and 9th ; Warren Hill, July 17th and 24th.

Chaffinch (*Fringilla coelebs*).—In good numbers. Many nests found.

Brambling (*Fringilla montifringilla*).—April 20th, small flock of about 17 seen in the birch woods behind High Beach Church, some in beautiful (almost summer) plumage. Probably the prevailing east winds were responsible for keeping them back till so late a date.

LINNET (*Acanthis cannabina*).—Chingford Plain, April 3rd; Gilwell Lane, April 23rd; Theydon Bois, July 3rd. April-June five nests found, three in Paul's Nursery and two on Warren Hill (all young reared).

LESSER REDPOLL (*Acanthis linaria cabaret*).—Frequently recorded out of the breeding season. Flock of over 200 seen near High Beach Church, April 20th. Unfinished nest found at Loughton; both birds watched, close up, with field glasses.

BRITISH BULLFINCH (*Pyrrhula pyrrhula pileata*).—Recorded throughout year. Several nests found on Warren and Ludgate Plains.

YELLOW HAMMER (*Emberiza citrinella*).—Recorded from March to July. Nest found on Warren Plain, early July.

REED BUNTING (*Emberiza schoeniclus*).—Great Monk Wood, small flock, January 2nd; February 20th; small flock, February 27th; Fairmead Bottom, February 27th and October 16th.

SKYLARK (*Alauda arvensis*).—Well recorded. Nest found, Warren Plain.

WHITE WAGTAIL (*Motacilla alba*).—One, or more, seen in a flock of Pied Wagtails on Chingford Plain, September 4th.

PIED WAGTAIL (*Motacilla lugubris*).—Recorded from Chingford Plain, Connaught Water, Hatch Plain, Honey Lane Quarters, Strawberry and Warren Hills. Nest found in trees, Warren Hill, early June, has nested here for many years.

GREY WAGTAIL (*Motacilla boarula*).— One seen in the grounds of Bancroft's School, Woodford Green, on October 31st. One seen on Hatch Plain, on December 16th and 25th.

TREE PIPIT (*Anthus trivialis*).—Common and singing well. Nest found near Strawberry Hill—young flew middle of July. First seen, April 2nd, Hawk Wood. Last seen, September 2nd, Fairmead.

BRITISH TREE CREEPER (*Certhia familiaris britannica*).—Common. Nest found with young, second week July, Warren Hill.

NUTHATCH (*Sitta caesia*).—Recorded throughout the year. Two nests found, with young, in July.

GOLDCREST (*Regulus regulus*).—Normal status maintained. Nest found, near Warren Plain, first week in July.

BRITISH GREAT TITMOUSE (*Parus major newtoni*).—Recorded from all parts throughout year—nests found in many places.

BRITISH COAL TITMOUSE (*Parus ater britannicus*).—Well recorded—many nests found.

BRITISH MARSH TITMOUSE (*Parus palustris dresseri*).—Well recorded.

BRITISH BLUE TITMOUSE (*Parus caeruleus obscurus*).—Very commonly observed—several nests found.

BRITISH LONG-TAILED TITMOUSE (*Ægithalus caudatus roseus*).—Numbers about as usual—several nests found.

RED-BACKED SHRIKE (*Lanius collurio*).—First observed, Fairmead, May 20th. Remarkably numerous in Warren Hill district—8 nests found. Several families observed on July 17th and 24th.

Whitethroat (*Sylvia communis*).—First observed Fairmead, April 13th—last seen, Long Hills, September 11th, 24 nests reported.

Lesser Whitethroat (*Sylvia curruca*).—Not so numerous as usual —first seen, Chingford Wood and Honey Lane Quarters, April 30th —last record, Chingford Plain, September 4th. Two nests found.

Garden Warbler (*Sylvia simplex*).—Common; first date, April 30th, Chingford Wood. Two nests found.

Blackcap (*Sylvia atricapilla*).—Well distributed. First observed, April 23rd, Bury Wood.

Grasshopper Warbler (*Locustella naevia*).—Seen and heard on Warren Hill throughout season. First seen, middle of May. Nest not discovered.

Willow Warbler (*Phylloscopus trochilus*).—First seen, Hawk Wood, April 3rd—last record, September 9th, Connaught Water. On April 17th, in spite of snow, sleet and piercing cold, the birds were singing well everywhere. Nests very common.

Wood Warbler (*Phylloscopus sibilatrix*).—First seen, April 30th, Hill Wood. Three nests found.

Chiffchaff (*Phylloscopus collybita*).—First date, March 24th, Paul's Nursery—last observed, September 17th, Strawberry Hill. Several nests found.

Missel Thrush (*Turdus viscivorus*).—Well distributed. Nest found Warren Hill. Observed eating fruit of service tree, October 16th and 29th.

British Song Thrush (*Turdus philomelus clarkii*).—Common—numbers decreased in winter months.

Redwing (*Turdus musicus*). Very scarce compared with previous year—probably owing to failure of haw-crop.

Fieldfare (*Turdus pilaris*).—Recorded only on December 25th, Highams Park.

Blackbird (*Turdus merula*).—Abundant—with increased numbers in winter.

Redstart (*Phoenicurus phoenicurus*).—First date, April 16th—last, September 19th. Four nests found.

British Redbreast (*Erithacus rubecula melophilus*).—Common.

Common Nightingale (*Luscinia megarhyncha*).—First recorded, Paul's Nursery, April 22nd. Observed in usual localities in about same numbers. Three nests found.

Stonechat (*Saxicola rubicola*).—Nest found, Loughton, early July, young reared.

Whinchat (*Saxicola rubetra*).—A pair seen, Fairmead Bottom, September 7th.

Wheatear (*Œnanthe œnanthe*).—Observed on Chingford Plain, September 4th.

Hedge Sparrow (*Prunella modularis*).—Well recorded. Several nests found (3 with Cuckoo's) first week in July.

Wren (*Troglodytes troglodytes*).—Very numerous. Several nests found; the unusual position of one calls for notice. This was built completely inside a hollow in a pollard, in which a small hole gave access to the nest.

Spotted Flycatcher (*Muscicapa striata*).—First seen, Loughton, May 20th. Last observed, Fairmead Bottom, September 7th.

Swallow (*Hirundo rustica*).—First recorded from Chingford Plain and High Beach, April 23rd. Last seen, October 2nd. More records than in previous year—common on Chingford Plain previous to migration.

Martin (*Delichon urbica*).—First seen, Strawberry Hill, April 29th. Last record, Chingford Plain, September 11th. Appeared to be less plentiful than usual.

Sand Martin (*Riparia riparia*).—Chingford Plain, August 21st—the only record.

British Great Spotted Woodpecker (*Dryobates major anglicus*).—The status of this species is well maintained, there being numerous records from the forest area between Chingford and Theydon. On March 12th, near Almshouse Plain, a male bird was observed taking grubs from marble galls which it first split open by repeated hammering. Four nests were under observation. In Hill Wood, a nest was found on June 4th, the young birds most vociferous. These had flown by the 12th. For the second year in succession a nesting hole in a crab tree, near Ludgate Plain, was found to be in use on May 15th. The young were heard "chanting" on the 28th. Near the same spot, a nest in a beech tree which had been used last year, contained young, May 28th. On June 12th a nest was found in Hawk Wood, in an ash tree, in which the young were calling. In Hill Wood, on June 12th and 19th, families of young, with adults in attendance, were moving about the trees.

Lesser Spotted Woodpecker (*Dryobates minor*).—Recorded from High Beach, Loughton Camp, Warren Hill, Ludgate Plain, Woodman's Glade, Chingford and Almshouse Plains. A nest found at Warren Hill, early July. On February 27th, this bird was observed attacking marble galls, of which it split three whilst being watched.

Green Woodpecker (*Picus viridis*).—Well distributed and recorded in every month of the year. Watched feeding on ants on Fairmead Bottom, October 2nd. During May the bird was seen at nesting hole in hornbeam, in Chingford Wood. Another nest found in an ash tree, near the Red Path, Chingford, on June 11th; parents seen and young heard.

Cuckoo (*Cuculus canorus*).—First observed, Fairmead, April 12th. Three nests of the Hedge Sparrow, each containing a Cuckoo's egg, were found during first week of July in thickets between Red Path and Epping New Road. Mr. H. C. Playne, of Bancroft's School, Woodford, gives the following interesting chronicle:—"One afternoon in June I noticed a Cuckoo repeatedly flying about my garden; and a few days afterwards it occurred to me that it might have been a hen looking for a nest in which to place an egg. So I examined the nests in my garden, and, on June 22nd, found a Robin in one of the boxes sitting on one of her own eggs and a Cuckoo's egg. This was the Robin's second nest. She had already reared one brood in an old saucepan near the box. On June 29th I found the young Cuckoo had hatched; and the Robin's egg was lying just outside the box. The young Cuckoo flourished exceedingly, and was as vicious a creature as usual . . . When I was feeling doubtful whether it would be able to get out of the box, it came outside and settled down in some ivy just above the box. Three days afterwards it disappeared with the Robins, and I did not see it again." (See "Bird Notes and News," winter number, 1921.)

Swift (*Micropus apus*).—First seen, Loughton, April 29th; last date, August 23rd, Clay Ride. Better recorded than last year.

Nightjar (*Caprimulgus europaeus*).—First observed May 12th, Clay Ride; last seen, August 30th, same place. On June 22nd at Sandpit Plain, "churring started at 9.50 p.m.—heard nightly at Warren Hill—nest found, middle of June, at Loughton.

Kingfisher (*Alcedo ispida*).—Connaught Water, February 20th; two, one fishing, February 27th; May 18th and November 6th; Eagle Pond, July 23rd; Golding's Hill Pond, September 3rd; Strawberry Hill, October 2nd; nested near Staple's Hill.

Tawny Owl (*Strix aluco*).—Chingford Wood, in flight and mobbed by Jays about noon, January 1st; in flight about 11.30 a.m. same place, January 22nd; Great Monk Wood, February 27th; near Ambresbury Banks, May 1st; Sandpit and Warren Plains, June 22nd; Black Bushes, mobbed by Jays, September 4th. Nested near "Royal Forest Hotel," young, late May.

Little Owl (*Carine noctua*).—Chingford Plain, September 3rd.

Sparrow Hawk (*Accipiter nisus*).—Fairmead, April 10th. Nest found early May to the south of High Beach; four young hatched off.

Kestrel (*Falco tinnunculus*).—Buttonseed Corner, flying over, January 30th; over field near Blackbush Plain, calling, February 20th; Yardley Hill, April 3rd; Chingford Plain, April 23rd; two males over Warren Hill, August 21st; Fairmead Bottom, November 6th and December 18th. An observer writes that a pair were to be usually found on Fairmead—several others were seen hovering in various parts of the forest.

Mute Swan (*Cygnus olor*).—Seen on Connaught Water and Highams Park Lake in spring and autumn.

Mallard (*Anas boschas*).—Frequently recorded from Connaught Water, also from Strawberry Hill Pond and Warren Pond. A brood of young seen on Connaught Water, May 11th; and two broods at the same place, June 4th.

Pochard (*Nyroca ferina*).—Connaught Water, one January 8th; 3 ♂ and 1 ♀, February 20th; and 2 ♂ and 1 ♀, March 13th.

Tufted Duck (*Nyroca fuligula*).—Connaught Water, 1 ♂, February 6th; 1 ♂ and 1 ♀, February 20th.

Common Heron (*Ardea cinerea*).—Mr. McKenzie reports on the Wanstead Heronry as follows:—"The keeper counted 69 nests, which is pretty well up to the average, and I think the hatch was a fairly successful one."

Woodcock (*Scolopax rusticola*).—One flushed by Keeper Stubbs, at Broomhill, on December 12th.

Curlew (*Numenius arquata*).—Calls were repeatedly heard from a large flock that passed over Loughton at night on September 7th.

Lapwing (*Vanellus vanellus*).—One flying over Long Hills, March 13th.

Black-headed Gull (*Larus ridibundus*).—Four on Connaught Water, December 4th.

Little Grebe (*Podiceps fluviatilis*).—Party of 4 nestlings seen with parent birds at the end of July on the Eagle Pond.

Moorhen (*Gallinula chloropus*).—Recorded from Connaught Water, Strawberry Hill Pond, and Highams Park Lake. Two adults and three young frequented the pond at Cuckoo Pits during July and August. Observed throughout season on the Eagle Pond, Snaresbrook, where thirty were noted at one time. On December 18th there were 27 on the lake at Highams Park.

Ring Dove (*Columba palumbus*).—Chingford Wood, (flock) January 1st and 30th and February 26th; near Red Path (flock), January 8th; Cuckoo Pits, February 5th and 20th; Hill Wood, April 3rd and 10th; Fairmead (flock), April 3rd; Honey Lane Quarters, April 30th; Fairmead Bottom, October 16th; near "Robin Hood," October 23rd; Long Hills, November 13th; Black Bushes, (several flocks), November 19th; Whitehall Plain (flock), December 18th.

Pheasant (*Phasianus colchicus*).—Round Thicket, March 19th, Long Hills (five), November 6th; Warren Plain, November 13th.

Partridge (*Perdix perdix*).—Almshouse Plain and Long Hills, February 20th; Theydon Bois, July 3rd.

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